SILICON CHIP

JANUARY 2010
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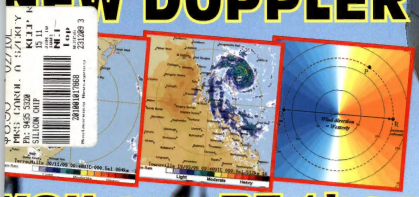

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HAPPY NEW YEAR FROM Jaycar Electronics

JANUARY 2010

12V Camping Shower

SAVE $5

Wash away the cares of the day with a warm bucket of soapy water and this excellent camping shower. Simply plugs into your car's cigarette lighter. Bliss.

- Pump, showerhead and carry bag all included

Was $24.95

$19.95 Cat: YS-2800

Stainless Steel Travel Mug with Built-in Heater

SAVE $5

This handy travel mug has a built-in, thermostatically controlled heater and will maintain one of four selectable preset temperature settings ranging from room temp to very hot.

- Includes 1.5m detachable 12V power lead with cigarette lighter plug

Was $34.95

$29.95 Cat: GH-1301

Dynamo Solar LED Torch

Great for camping and for the car. Just a few cranks on the handle and it will give you a super bright light consisting of 3 LEDs. Also features a solar panel to keep it charged and ready to use.

- Dimensions: 150(L) X 50(W) X 30(D)mm

$19.95 Cat: ST-3345 *Was $29.95*

SAVE $10

38 Channel UHF CB Twin Pack

Even out in the bush where there's no mobile phone reception, these mini CBs keeps them in touch up to a 3km range. Features electronic volume control, monitor functions and an integrated blue LED torch. Supplied as a pair, in funky orange and green.

- Requires 3 x AAA batteries per unit
- 38 Channels
- Dimensions: 55mm(W) x 110mm(H) x 35mm(D)

Was $54.95

$44.95 Cat: DC-1005

SAVE $10

12V Portable Stove

SAVE $10

Cooks, warms or reheats at up to 125°C. Deep lid design, with a case made from durable ABS plastic and carrying handles.

- Measures: 265(L) x 180(W) x 155(H)mm

Was $49.95

$39.95 Cat: YS-2808

12V Air Pump

SAVE $3

Great to use on air beds, beach balls, lilos/jacks, rafts etc. Operates from any 12 volt outlet and is supplied with 3 sized nozzles to fit almost any item.

Limited Stock *Was $12.95*

$9.95 Cat: GH-1110

NEW Stainless 1W CREE® Tactical LED Torch

Tough as nails and built for security, law enforcement and military use. This 1watt Cree® LED torch is machined from a solid bar of 304 18/8 stainless steel and is O-ring sealed. 80 lumens bright with a tactical tailcap switch.

- Requires 3 x AAA batteries
- Lanyard included
- Dimensions: 130(L) x 31(Dia)mm

Was $59

$45 Cat: ST-3398

SAVE $14

150W Inverter with USB Outlet

This compact (150mm long) inverter plugs directly into your vehicle's cigarette lighter socket to deliver 230VAC at 150 watts. The modified sine wave unit comes with a USB port to charge or power your MP3 player or other USB operated device.

- 150(L) x 75(W) x 40(H)mm

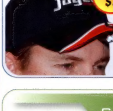
Was $59.95

SAVE $10

$49.95 Cat: MI-5125

5 LED Cap Light

SAVE $7



This 5 LED light clips onto a baseball cap and provides a brilliant white light. Perfect for those who prefer a simple head-lighting solution

- Ultra-bright 5 LED array
- Burn Time: Up to 18 hours
- Output: 9 lumens

Note: Cap not included *Was $16.95*

$9.95 Cat: ST-3281

Rechargeable 35W HID Spotlight

With an impressive 3300 lumens, this spotlight is ideally suited to search and rescue, boating, professional shooters, security or other high-power applications. It's housed in a tough weather-resistant ABS housing and has a handy shoulder strap for extended use. The built-in rechargeable battery gives about 50 minutes of continuous use and it recharges either from the mains plugpack or a car cigarette lighter socket.

MORE INFO ONLINE

SAVE $16

- Type: HID Xenon lamp
- Voltage: 12V
- Power: 35W
- Dimensions: 300(L) x 210(Dia)mm

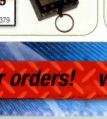
Was $165

$149 Cat: ST-3369

Spare globes also available Cat. ST-3363 $39.95

Multi-function Survival Compass

SAVE $8



Easy-to-use compass and the focus beam torch can provide strong lighting and light up the compass dial for crystal clear readings in poor light. Additional features include a digital clock, thermometer and a flashlight alarm.

- Requires 2 x AAA batteries
- Closed dimensions: 56(L) x 90(W) x 23(H)mm

Limited Stock *Was $19.95*

$11.95 Cat: XC-0379

*Savings off original RRP

Prices valid until 23rd January 2010

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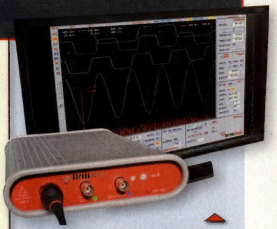

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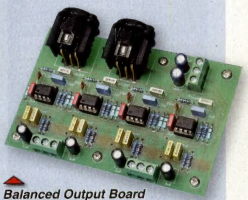

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Publisher's Letter

Wind power is no substitute for base-load generators

Back in the July 2009 issue we featured a story on Sydney's water desalination plant together with a panel entitled "Where does the electricity come from?" As explained in the panel, the state government has decided to build wind farms to generate the power which would otherwise come from coal-fired base load power stations, albeit at a higher price.

But in the this month's Mailbag pages, reader Paul Miskelly points to the fallacy in this arrangement. Desalination plants must run continuously and therefore must draw their substantial electricity requirement from the grid all the time. Paul Miskelly has taken the trouble to analyse the figures for wind farm output and has produced graphs which clearly indicate that wind power is a very variable source – hardly suitable for running a desalination plant.

It is stating the blindingly obvious to say that the wind does not blow all the time. But it doesn't and for the politicians and public servants to try and pass off wind power as a "green solution" is just a lie. When the wind stops blowing, all the electricity required by the desalination plant must come from the coal-fired power stations. There are no ifs, buts or maybes. And one can envisage a situation where, if there was a major overload on the grid and the wind wasn't blowing, the desalination plant would be one of the last to be subject to "load shedding". In other words, normal commercial and domestic consumers will be blacked out long before the desalination plant.

I remember some years ago having lunch with one of the magazine's advertisers and the subject of the mooted Sydney desalination plant came up. I wondered out loud where the power for the plant should come from. Nuclear power was the instant and only practical answer. "Where should we put it?" was the next question. The immediate answer was "Right next to the desalination plant at Kurnell!" Then "How big should it be?" and the answer was "A bloody big one!" And while the answers to the questions may have been glib, they were absolutely correct and practical.

Desalination plants need lots of power and nuclear plants can provide that power on a relatively small site with no air pollution at all. None. Since such a large amount of power is required, it makes sense to site the power plant right next to the desal plant, to minimise transmission losses. And since Sydney requires more base load power in any case, having the nuclear power station adjacent to the city also makes sense, to minimise transmission losses. That's how they do it in many other parts of the world.

Sadly, while everything we discussed was and is correct and practical, nothing like that is ever likely to eventuate even in the far future, given that State and Federal governments appear to be so inimical to the concept.

But those people who say that we can rely more on renewable energy sources must face the fact that when those source are not available, such as when the wind is not blowing, then the base-load power stations must be able to take up all the slack. Unfortunately though, all of the interconnected electricity grid for the eastern states of Australia is running very close to capacity, especially in the summer months.

Finally, those people who point to European countries which apparently have a much higher component of their electricity coming from wind power should realise that those same countries buy their electricity from nuclear-powered France when the wind doesn't blow. Furthermore, those countries that have invested heavily in renewable energy, such as Spain with its government-mandated solar energy, are paying much more for their energy. That is now recognised as a gross misallocation of resources.

Leo Simpson

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National broadband network will waste power

I agree with your observations and concerns regarding the government's proposed NBN FTTH network (Publisher's Letter, November 2009). Like you, I am convinced that the government is committed to separating Telstra in order to gain access to the underground duct infrastructure without proper and fair compensation.

While it may be valid to deplore the crippling of upload speed on the FTTH network, my major question is whether it is absolutely necessary for the average home to have access to 100MBit/s download speed. A home-owner might think it is cute to be able to view a full length movie in real time on a networked TV set but this is a very poor justification for piping such a wide bandwidth into every home.

My contention is that FTTH for 99% of the population is well and truly overkill and the expense of $43 billion can not be justified. I contend that all that is required by the average home is a minimum 15MBit/s which can be adequately provided by a much less expensive network using FTTN.

While it would be possible to allow existing exchange switches to provide standard POTS over the old copper cables while transferring the high-speed services to the fibre, this is unlikely to be considered economically justifiable. After all, why run a fibre to every home just to provide a high-speed internet service? So it is probable that fixed-line telephone services would operate using VoIP over the fibre connection. But this service will only be reliable if the home fibre terminal is powered by a UPS.

It would also mean that the existing exchange infrastructure would be redundant despite it being capable of providing reliable telephony service for many years yet.

Another point which I have wondered about is the comparison between energy costs associated with a FTTH network as compared to a FTTN network. As I understand it, a FTTH network requires every home to have a fibre terminal which must be powered from the domestic mains supply and if the customer wants to have an uninterrupted service the terminal must also have a UPS. These terminals will be the responsibility of the home owner to maintain and to pay for the power which runs them.

If my maths are correct, each terminal consumes around 15W. So if there are eight million households, the standing power requirement will be 120 megawatts just to keep the FTTH terminals operational – even when they aren't actually doing anything for the major period of each day. This isn't very green in my opinion.

In contrast, I would estimate that a FTTH network would consume far less power because only the fibre nodes would have to be powered and this would be performed by the telco (eg, Telstra) via their underground cables in much the same way as the Foxtel cable is now powered.

Since the exchange power is battery-backed and the exchange possibly has a diesel generator to cater for long outages, the customer would still have a reliable network and telephone connection, exactly the same as is now provided over copper. Only the high speed internet connection using DSL would be transferred to the fibre nodes which serve up to 1000 customers while the existing fixed-line telephone service would continue to be provided over the existing copper cables.

The customer would only have to maintain responsibility for his own network modem etc as he currently does and fixed line telephones would not need to be upgraded to VoIP telephones or to be powered using a UPS. All in all, a FTTN NBN makes more sense in the short to mid term and it also provides a logical phased integration platform for a fully blown FTTH network when it is economically viable.

Ross Herbert,
Carine, WA.

Great service on faulty kit

I recently purchased a Digital Audio Generator (SILICON CHIP, June 2009) kit from Altronics and on completion found I had a display problem in that it just showed a series of dark squares on the LCD, although some of the tones appeared to be working.

Contact via email was made with Daniel from the Altronics mail order department in Perth and after a bright cheery conversation he said he would pop upstairs and if there was a programmed PIC there, he would send it to me. That was Friday morning, Perth time and on the following Monday afternoon a parcel arrived on my doorstep in Dunedin, New Zealand. Now that's what I call service!

Unfortunately, the replacement PIC did not fix the fault and after one more email, another PIC and an LCD module were sent with similar speed, along with some discount vouchers for my troubles. This time the problem was fixed and I can say I am very pleased with the kit and the after-sales service I received from Altronics.

Peter Hamlyn,
Dunedin, NZ.

Flinders University pioneered EV development in Australia

David Richardson's letter in the September 2009 issue, which was in response to your Editorial comment

regarding a 3-phase powered electric vehicle, suggests that the Flinders University of SA may have constructed a 3-phase powered electric vehicle during the 1990s.

I believe that a DC to 3-phase control system for an electric vehicle was developed at a Tasmanian University in the late 1970s or early 1980s. I recollect seeing a photograph of this system and an ASEA motor fitted into a passenger vehicle.

The Flinders University electric vehicles were constructed in the late 1970s, early 1980s – not 10 years ago. We were 30 years ahead of the current enthusiasts!

The first FUEVG (Flinders University of SA Electric Vehicle Group) vehicle was a space frame with a wheel at each corner. It was not constructed on a Mini Moke chassis but it did bear a passing resemblance to that iconic vehicle. The DC motor ran at constant speed, powering an hydraulic variable-speed transmission. The batteries, as in all FUEVG vehicles, were lead-acid cells.

The second FUEVG vehicle was a small Fiat which on completion only had two seats. The battery pack was variable voltage feeding a DC printed circuit permanent magnet modular motor. This used the manual gearbox and clutch to drive the wheels. Regenerative braking was used.

The third FUEVG vehicle commenced was a Laser sedan which on completion had four seats. The battery pack was variable voltage feeding a DC printed circuit permanent magnet four module motor. This used the standard clutch and the manual gearbox to drive the wheels.

Regenerative braking was used and the motors were modular, with the number of modules being varied to provide for differing power requirements. The Laser, despite being commenced before the fourth and fifth vehicles, was not completed until after the vans (see below).

The fourth and fifth FUEVG vehicles commenced were Bedford vans. The variable-voltage battery pack was interchangeable to enable "refuelling" at a battery exchange facility in less than three and a half minutes; about the same as a quick petrol refill.

The battery pack, which weighed approximately one tonne, fed the DC printed circuit permanent magnet 6-module motor connected through the clutch and the manual gearbox driving the rear wheels. Regenerative braking was used. The number of modules chosen for the motor was based on the required power.

Two battery exchange facilities were built and developed by the FUEVG, with one at the Flinders University

Dodgy rechargeable torches again

Following the letter on dodgy torches in the Mailbag pages of the December 2009 issue, my experience with dodgy rechargeable torches is a brand which I found at a camping goods store. It is a key-ring type torch with a fold-away crank handle on the side.

The generator does actually charge the batteries, however the rechargeable battery stack is held together with a shrunken plastic sleeve. However the resulting tension is not adequate and so the battery stack forms a bad connection and so can not deliver the charge to the LEDs.

I found that a short length of tape wrapped tightly around the battery stack cured the problem, however most people would simply throw it away resulting in more metals and plastics going to landfill and wasting of the energy used in manufacturing and transportation.

Maybe it's time that there was legislation mandating a minimum life for products that fail such tests. It might cost a few more cents for something made that bit better but the additional cost would be quickly recouped by not having to buy another one in a few days/weeks.

John Evans,
Macgregor, ACT.

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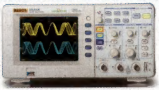

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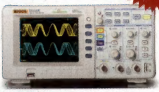

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Mailbag: continued

Compact fluorescents are not the solution to energy conservation

This CFL issue is an ugly monster. Who in government knows anything about science or engineering? Household incandescent lamps were banned from import last year without an effective replacement.

It seems halogen lamps may be more suitable than compact fluorescent lamps although they use more power. People are now forced to buy and install CFLs in place of incandescents, not knowing that if they have too many on the one circuit that switching them on together can keep tripping your breaker (or fuse).

The free CFL handout campaign didn't warn of using too many on one circuit or that you may have to change your circuit breaker to a "D" curve type to overcome the surge. How much will that cost? So much for free lamps.

CFLs use a miniature switchmode supply of say 8W, 18W etc. So they have a switch-on surge from the input capacitor charging, leading to problems in some cases.

They also have a turn-on delay, some flicker and some have an awful colour and very few can be dimmed. They have no soft-start and no power factor correction. I have actually measured some and they operate at about PF = 0.5. This means that an 18W CFL is actually 36VA. This means that the supply authority always has to struggle to "correct" or "balance" the power factor, leading to higher maintenance costs and who pays for that?

How much energy will I save if I changed my toilet lamp which only switches on four or five times at night for about three minutes each time? I doubt if I would ever notice. CFLs are OK for constant lighting which stay on for long periods but not for short, frequent switching and are no good for automatic timers or dimming.

By the way, I have two CFLs and standard 2-foot fluoros in my garage where I work for extended periods. I also have four automatic timers so CFLs are excluded there.

I believe LED lighting is the real technology that will eventually prevail.

Sal Sidoti,
Lilyfield, NSW.

and the other in the City of Adelaide. Other work by the FUEVG was on the development of the lead-acid batteries which constituted the "roadworthy" state of the art 30 years ago. This resulted in significant improvements in energy capacity, increased the number of cycles achieved during a battery's life, greater mechanical robustness and longer service life in an EV. (The resulting improved performance and lower production costs enabled the co-operating factory in Adelaide to export batteries to their parent company in UK).

Parallel work on battery chargers resulted in higher efficiencies, improved power factors, lower line currents, reduced line and radiated interference and faster charging to full capacity. This resulted in lower stresses on the battery structure, in turn leading to longer battery life.

Considerable data was gathered on the operating costs and experiences with the vehicles, both on-road and on the FUEVG-developed computer controlled dynamometer (normal wheel-coupled dynamometers cannot simulate regenerative braking!). The battery improvements were proven by the data from the computer-controlled battery test facility and these improvements incorporated into the 1-tonne packs for operational on-road testing.

As a result of the FUEVG achievements with the vans, the variable voltage batteries, modular motors and battery exchange facilities, the SA Government decided to support a pilot manufacturing project to produce, I believe, 10 or more vans. A commercial developer was contracted and I believe the SA Government diverted all EV funding to the commercial manufacturing project.

Due to lack of financial support by the State, the Federal Government fi-

nancial support also disappeared, with the resultant demise of the FUEVG.

Roger Pullem,
Adelaide, SA.

High atmosphere CO_2 doesn't cause global warming

I note your editorial comment about the flood of emails but I am afraid that Cliff Hignett's letter cannot go unanswered. He suggests we look into the IPCC reports. Following the release of the emails from the University of East Anglia, does he honestly expect people to believe anything the IPCC says? The emails imply scores of university researchers, some of whom are associated with the IPCC, engaged in fraudulent reporting of data to favour their own climate change agenda.

You published Mr Hignett's graph of atmospheric CO_2 over the last 650,000 years and it is interesting. However Professor Plimer's graph of the past 600 million years (page 242) with both CO_2 and temperature integrated is more so, as it shows the hypothesis that high atmospheric CO_2 produces global warming is invalid.

John Brown,
Bibra Lake, WA.

Criticism of Pest Free II review

I am somewhat disappointed by the technical level of your review of the Pest Free II device in the December 2009 issue. In particular, the claim that the coil would not work are way off the mark. Some simple measurements with an LCR meter would provide you with some hard data.

An interesting and worthwhile experiment is to energise the coil in question or a similar one, with a small AC voltage at an audio frequency and use a small pickup coil to map out the resulting magnetic field.

An audio amplifier, DVM or CRO are all suitable for monitoring the voltage induced in the pickup coil. Mapping out the magnetic field with and without the aluminium cheeks will demonstrate the effect of a "shorted turn" in close proximity to the coil. The magnetic circuit of the coil illustrated is essentially air, so these effects will be easily seen.

The CRO images you published show, I suspect, the effect of a significant amount of capacitive coupling into your measuring system. A few simple calculations and checks to show you are measuring the magnetic component of the EM fields present would have enhanced your review considerably.

Philip Jones,
Gordon, NSW.

Comment: in fact, we did more tests than were alluded to in the review. We did use a small coil around the Pest Free II but were unable to measure any meaningful signal. And we did use a Peak LCR meter to check the coil. We found it to be a high resistance – 4.8kΩ. Because of that high resistance, the LCR meter was not able to measure it as an inductor. Further investigation showed that it was wound with very fine gauge wire.

Perhaps we should have mentioned this in the review. In fact, after the article was written and sent to press, we actually tried the effect of removing the aluminium cheeks but it had no effect on the radiated magnetic field. When you consider the high resistance of the coil, you can see why.

It all begs the question: why have all that componentry to actually do nothing?

Query on wiring standards

The company I work for is often engaged in mounting and wiring instruments and components inside various size cabinets or enclosures. Recently, one of our technicians was taken to task over the way in which he had wired up a project.

According to our electrical supervisor, it is not permitted to use black & red as plus/minus low voltage wiring if the same enclosure has mains voltage connected internally. Although the mains cable is brown, blue and yellow/green, we are told that the SAA regards red & black wiring as mains wiring as well. In fact the blue/brown should be connected to the circuit breaker on the input side and the output side is supposed to be red and black which is terminated to the transformer or any other device requiring mains voltage as its primary input.

Some of your projects show the internal wiring with black & red as low voltage wiring. I wonder if you could clarify the situation as I assume

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Wind farms & desalination

Firstly, congratulations to Leo Simpson for his July 2009 Publisher's Letter for his easy-to-understand explanation of the complex topic exploring both the relative impacts of the use of coal versus gas for electricity generation, and the relative thermodynamic efficiencies of the respective power plants.

Thanks to Geoff Graham for the excellent article in the same issue, explaining the mysteries of water desalination. The article makes it clear that, given the special requirements to protect and maintain the reverse osmosis membranes at the heart of the system, the plant is best operated continuously at full capacity. Therefore, from day one of operation, the desalination plant has not only a base load requirement on the grid but as well, this requirement must be sourced from a rock-solid, secure supply of electricity.

With this requirement firmly in mind then, I would like to comment on the content of the sidebar to the article entitled: "Where does the electricity come from?" This sidebar article claims that the principal source of the required electricity will be a wind farm

As illustrated in the graph shown in Fig.1, wind farms produce a highly variable, highly erratic and totally unpredictable electricity output. In addition, wind farms often produce zero output for long periods of time. Indeed, they draw significant amounts of electricity from the grid during those periods.

Wind farm owners always quote the average annual output, never publicising the degree of variability in that output. It may be instructive to consider the output to date of the Capital Wind Farm near Bungendore, one of those identified by the NSW Premier as being the source of the 100% renewable electricity supply for the Kurnell desalination plant.

The attached graph (Fig.1), compiled from AEMO-published data, shows the output for the period 30th June 2009 - 24th October 2009. (The Australian Energy Market Operator [AEMO] is responsible for the secure and reliable operation of the eastern Australian electricity grid). It is noteworthy that there are very long periods of zero output and where there is generation, the pattern is extremely spiky.

The kindest thing that one can say about this performance is that it is totally unmatched to the requirements of a desalination plant.

While it may seem acceptable for their owners to quote wind farm operation in terms of averages, a desalination plant cannot be run on averages or indeed any other statistic. The reality is that while the desalination plant is operational, electricity has to be supplied to it from a reliable, constant source. Therefore, to propose that there is some sort of link between wind farm-generated electricity and the requirements of the desalination plant is tenuous at best.

In my view, it is a grossly misleading claim. This claim – that wind farms might be used to fully supply the electricity requirements of a desalination plant – is but one of the many unsustainable claims concerning wind farms.

Should readers wish to access the operational data of the Capital Wind Farm or indeed that of any of the other major wind farms connected to the eastern Australian grid, to check the operational data for themselves, instructions as to which links to access, etc can be supplied. Alternatively, readers might like to access the website **http://www.landscapeguardians.org.au/data/aemo** to download operational data from an updated-daily database holding AEMO-sourced information.

Professional electrical engineers in particular and other readers of SILICON CHIP who choose to perform even a preliminary analysis of this data will very quickly realise the futility of connecting wind farms to the electricity grid. Not only is the output from any single wind farm highly erratic but the sum of the outputs, far from being smoothed by wide geographic dispersion (a claim stated as mantra by wind

that your projects must come under the scrutiny of your local regulatory authorities?

John Hoskins, Swispec Pty Ltd, Bunbury, WA.

Comment: according to the Australian wiring standards, AS/NZS 3000:2007 clause 3.8.1, Earths must be green/yellow, Neutral black or light blue and Active is any colour other than green, yellow, green/yellow, black or light blue.

Recommended Active wire colours are red or brown for single phase and red, white or dark blue for multi-phase.

For low-voltage wiring via a transformer (clauses 7.5 and following) there does not appear to be any mention of specific colours of wires that should or should not be used. Since mains transformers use red and black secondary wires and do comply with AS/NZS 61558.2.6 and AS3108, it would seem that red and black can be used for low-voltage wiring.

We agree that the green/yellow earth wire should only be used for earth wiring only, as inferred in AS/NZS 3000:2007 clause 3.8.1.

Climate change debate too divisive

I look forward to the SILICON CHIP editorial where Leo outlines his views on abortion. NOT! Climate change sceptics are like drinkers about to leave a party and drive home. Arguing with them is pointless. They have done this a thousand times before, have never had a problem, getting a taxi is too hard and returning for the vehicle too inconvenient.

Whether their actions are safe or not is not the issue – it is the risk and the increased probability of injury. Speeding and drink-driving will not guarantee injury, any more than pumping carbon dioxide into the atmosphere will guarantee global warming.

However, most people accept that the consequences of drink driving

energy's proponents), is even more spiky and destabilising to the grid's continued operation. Why it has been left to privateers such as myself to perform such an analysis and to highlight the inherent problems in grid-connected wind generation beggars belief.

To better show the extent of the detail available, Fig.2 is a graph of the output of the same Capital Wind Farm using the final month of the data shown above. The data points used to generate both graphs are at intervals of five minutes.

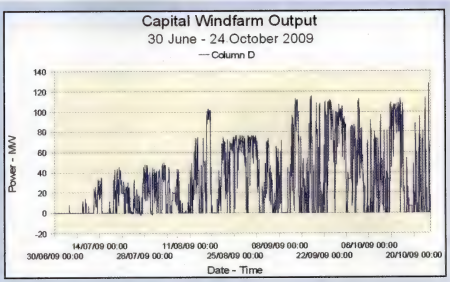
To supply the requirements of the desalination plant, the troughs and gaps in this output would have to be smoothed by an open-cycle gas turbine plant (OCGT) operating in a very inefficient manner. OCGT's have much lower thermal efficiencies than the CCGT's described in Mr Simpson's July 2009 editorial.

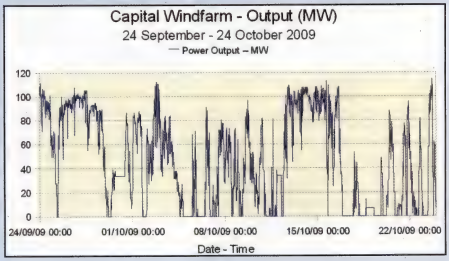
Dare one suggest that the CCGT plant described in Mr Simpson's editorial would make a more suitable source of electricity for the desalination plant? Indeed, one could. Such a plant could be built nearby as the dedicated, sole, continuous source of supply to the desalination plant.

With its thermal conditions optimised to operate at maximum efficiency, this CCGT generator would provide the most environmentally friendly of generation technologies currently available in Australia to deliver the electricity requirements for this controversial plant.

Whatever one's view in the climate-change debate, this data shows that grid-connected wind farms can never make any useful contribution to reducing CO_2 emissions.

Paul Miskelly,
Mittagong, NSW.





far outweigh the conveniences. Similarly, the costs and inconveniences of reducing greenhouse gases, even if unnecessary, are small compared to the potential consequences.

Giving Steve Fielding credence because he is an engineer is going too far. For over 20 years, I have been presenting my fellow engineers and other technical people with the Monty Hall Problem (see Google). They invariably make the wrong choice and refuse to acknowledge their error, no matter what. It often takes weeks to wear them down to the point where they

Mailbag: continued

Criticism on inclusion of letter from Ian Plimer

I have grown tired of Leo Simpson using this magazine month after month to push his views on the topic of anthropogenic (man made) climate change, which in my opinion has reached the point where it is seriously harming the magazine's reputation. In his latest instalment (October 2009), Mr Simpson states in his Publisher's Letter that he is "very pleased to publish a long letter" from Ian Plimer, which like his book "Heaven and Earth", continues to promote falsehoods.

For example, Plimer states in his letter that (global average) temperature has decreased since 1998, which I consider to be a very significant statement. His book does likewise on p391 which states: "The Hadley Centre in the UK has shown that warming stopped in 1998". It is perhaps not surprising that Prof. Plimer does not cite a reference for that claim, as in fact the Hadley Centre is on record as saying the complete opposite (**http://www.metoffice.gov.uk/corporate/pressoffice/2008/warming_goes_on.pdf**), commencing with the headline "Anyone who thinks global warming has stopped has their head in the sand". They further state: "The evidence is clear – the long-term trend is that global temperatures are rising, and humans are largely responsible for this rise.

Global warming does not mean that each year will be warmer than the last. Natural phenomena will mean that some years will be much warmer and others cooler. You only need to look at 1998 to see a record-breaking warm year caused by a very strong El Niño. In the last couple of years, the underlying warming is partially masked, caused by a strong La Niña.

Despite this, 11 of the last 13 years were the warmest ever recorded. [...] Over the last 10 years, global temperatures have warmed more slowly than the long-term trend. But this does not mean that global warming has slowed down or even stopped. It is entirely consistent with our understanding of natural fluctuations of the climate within a trend of continued long-term warming."

I find it difficult to believe that Prof. Plimer was not aware of the Hadley Centre's true position when he wrote his recent letter to SILICON CHIP.

There is a wealth of information readily available that refutes many of Plimer's other arguments in sufficient detail to permit independent verification of the facts by true sceptics. For example, the one compiled by Ian Enting of the University of Melbourne runs to 46 pages alone – **http://www.complex.org.au/tiki-download_file.php?fileId=91**

A true sceptic would take into consideration the many documented problems with Mr Plimer's book, which, as far as I am aware, Prof. Plimer has never seen fit to refute and as evidenced by his letter, he perpetuates. Perhaps he has not refuted them because he simply can not do so on scientific grounds. Or perhaps he has not done so because the controversy generates increased book sales. Either way, it does him no credit to remain silent in the face of such overwhelming criticism.

It also does the magazine no credit for Mr Simpson to publish a letter containing material errors of fact such as the one I cited above. From his past writings I very much doubt that Mr Simpson falls into the category of a genuine sceptic of anthropogenic climate change, for if he did, he would likely have been well aware of the problems associated with Prof. Plimer's claims and questioned the merit of publishing them without first verifying their validity.

Although I do not expect anything I have written to alter Mr Simpson's viewpoint on the topic, I do hope he finally sees fit to move on to one more appropriate to the purpose of this magazine.

L. Pickersgill,
Mt. Lawley, WA.

will accept the correct method. The more technical the person, the more stubborn they are in sticking to their original incorrect assumption.

I believe that there are more important political issues that are relevant to SILICON CHIP readers than nuclear energy or climate change, which are divisive. These issues include nanny-state electrical laws, incandescent globes, digital radio and television, NBN and minimum efficiency standards etc. I know that these have been addressed before but there is still much to be discussed and these are more resolvable and less divisive than the hot potatoes of nuclear energy or climate change.

Mark Baker,
South Perth, WA.

Comment: while you may think that climate sceptics are ratbags, perhaps you should look at some other information which indicates that in fact, the Earth may be cooling. If you don't accept that, the fact that the Sun is going through a period of record low activity cannot be denied.

We do not resile from discussing climate change and the economic and technical ramifications of attempting to fix it with such ill-conceived measures as ETS, CPRS and CCS. SILICON CHIP is one of the few magazines where criticism of these measures has been raised. In fact, until the Publisher's Letter entitled "Let's have no more of this carbon pollution nonsense" in the June 2009 issue, virtually no writer in the general media had even seen the silliness of the term "carbon pollution".

Praise for Class-A amplifier

I would just like to let you know that I have just completed construction of your class-A 20W/channel amplifier from an Altronics kit. I have it connected to a high-end Yamaha CD player and a pair of VAF Research DCX Gen IV speakers.

In my opinion, the quality of sound is as good as you will ever hear from any system, regardless of price or manufacturer. Congratulations and well done for what is undoubtedly a world-class amplifier.

Ron Barnes,
Otago Bay, Tas.

Call blocking wanted for telemarketers

I despise telemarketing callers. If there was something I needed that they were selling, I'd have gone looking for it already. The "do not call" register is a solution that is no solution because you are simply adding your details to yet another database.

The problem is that the telecommunications carriers provide telemarketing companies with the means to invade my space. My phone services (landline, mobile, VoIP) all have a call blocking facility but you actually need to have a number to block. CLID for telemarketers are generally "Unavailable" or "Private Number". More recently, they have started using 028 numbers. You can't block those numberless calls with call blocking.

I decided that since my telecommunications carrier gave the telemarketers the means to invade my space, the telecommunications carrier is legally obliged to provide me with the means to block numberless calls or divert them to voice mail (by my choice). Calls to the carrier on this subject are met with some disdain.

Now that I have had my say on this issue, I wonder if you might be able to develop a project, perhaps using a PICAXE solution, that can sit on my landline before the handset, examine the CLID and divert or reject (by user setting) numberless calls. I understand that there may be issues with telecommunications equipment regulation compliance but this should not be insurmountable given the gamut of devices that meet the regulations from foreign sources and do the oddest of things.

Gary Broughton,
Renmark SA.

Comment: your use of the word "despise" is very appropriate. One partial way of stopping nuisance calls is to listen to all incoming calls via an answering machine. That way you can elect whether or not to pick up the phone, if you happen to be at home at the time.

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Crystal clocks with sweep second hands may not last

I was not impressed by the lifespan of a tick-less wall clock that I purchased recently. It has a 27cm diameter dial but only worked for some 51 weeks before stopping.

If I rotate the clock through 180° so that the 6 o'clock position is topmost, the clock will run again, albeit very noisily. My guess is that because the single coil stepper motor rotor has to rotate 16 times each second, the rotor bearing areas wear out much quicker than the traditional one tick per second rotor. My previous crystal clocks have lasted over five years.

I replaced the worn-out clock mechanism (but kept the original hands) with the Jaycar XC-0100 kit, which was cheaper than buying a new clock.

Anthony Farrell,
Chinderah, NSW. SC

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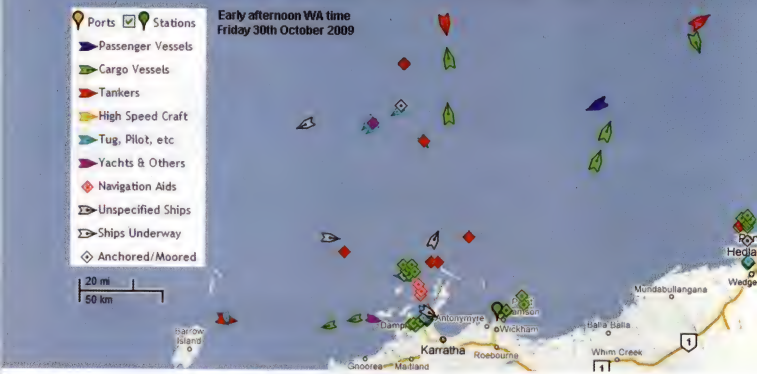
Going "tropo" in the tropics . . .

AIS in the Pilbara

by Stan Swan

Regular SILICON CHIP readers will recall Stan Swan's AIS article in August 2009. It's not stretching the truth to say it has stirred an enormous amount of interest. But we bemoaned the fact that there appeared to be very little coverage in Australia's north west.



So it's been pleasing to note the welcome establishment of fresh 162MHz marine monitoring stations on both the NZ and the vast Australian coastlines.

Perhaps the most notable recent installation has been that near Dampier on the north west coast of WA, as its associated marine traffic web feed has dramatically served to show the scale and intensity of ore and gas shipments from the Pilbara region.

"Like bees 'round a honeypot" was one comment arising after viewing the associated AIS activity.

Shore-based observers would only see a handful of ships at a time and hence may never be conscious of the virtual armada lurking over the horizon! At the time of writing (early November 2009) around 100 vessels were often ~~detected~~, with many in shipping lanes stretching clear to In-

How far can you see (or LOS radio waves travel? Simply use this formula – don't forget that both your height and the height of the ship's AIS transmitter make a considerable difference.

The Dampier AIS receiving station is hidden amongst the giant communications antenna farm. It was originally set up to house the local amateur radio repeater. The AIS antenna is that tiny 1/4-wave whip (highlighted) on the roof of the building in the foreground. Normally only line-of-sight, under seasonal "tropo ducting" this often receives VHF marine radio signals out to 1000km away!

donesia, almost 1000km away.

Coastal viewers have a visual horizon at distance D (in km), related to the observer's altitude H (in m), by the formula $D = \sqrt{(13 \times H)}$.

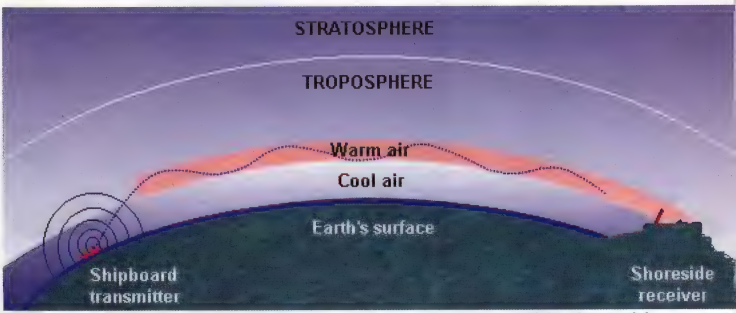
Although downward refraction ("bending") gives modest VHF coverage a little beyond this range, such signals essentially propagate line of sight (LOS), meaning a radio horizon of perhaps just 20km or so for most ship-mounted AIS antennas.

Going tropo

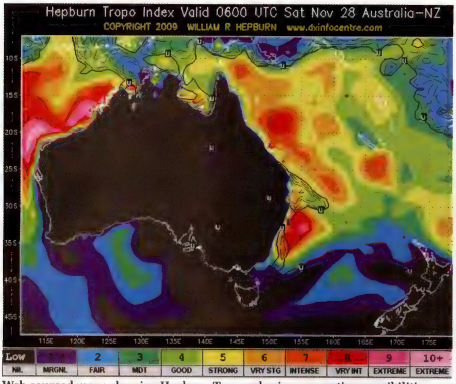
So how then can these numerous Dampier vessels, many "hidden" well below the earth's curvature, be so readily detected in this region using such simple technology?

The answer relates to seasonal tropospheric propagation enhancement, well known to arise about now in that region.

The troposphere forms the earth's



Tropospheric propagation allows reception many, many times that suggested by the diagram at left. In fact, signals have travelled 1000km and more, sometimes resulting in confusion with VHF radio networks!



Web-sourced maps showing Hepburn Tropospheric propagation possibilities give invaluable insights into tropo enhancement. It's indeed fortunate that the Pilbara region experiences both intense seasonal tropo ducting and massive off shore AIS activity, as productive "data mining" insights (technical and commercial) may result.

lowest atmospheric layer and under suitable conditions higher frequency electromagnetic waves can become trapped near ground level.

Such "tropo" propagation typically occurs during periods of stable, anticyclonic weather and usually relates to a thin layer of warm dry air blanketing cooler surface air.

Temperature inversions of this type are often encountered when hot summer air (perhaps from deserts) overlays cooler ocean water – fogs are often a visible sign.

Unlike near-space ionospheric reflections (greatly influencing medium and short wave reception), it's the very-much-higher frequencies (VHF, UHF and microwaves) that are usually more favourably tropo propagated.

Diverse tropo enhancement effects are known but wave-guide style refractive *ducting* is the most pronounced.

Ducted signals may travel more than 1000 km, leading to unexpectedly long distance reception (under these conditions Australian eastern state FM radio stations may become audible across the Tasman in NZ.

Such ducted propagation is usually blocked by mountains. Ground level receivers may be below a tropo-enhanced layer, yet signals could be readily received when on perhaps a 300m hilltop.

Long distance ("DX") tropo reception is often associated with powerful FM and TV broadcasters.

In some parts of the world, notably the Mediterranean Sea, Carribean and Persian Gulf, tropospheric ducting conditions can become so established during summer months that viewers regularly receive good quality VHF/UHF terrestrial TV signals over great distances.

Prior to satellite TV, such "tropo season" reception greatly annoyed totalitarian authorities in countries (such as Cuba) attempting to restrict external information!

Radio amateurs have long strived for long-distance (DX) contacts via weak VHF/UHF signals. Thanks to the global tropo forecasts of Canadian (and professional meteorologist) William Hepburn – hosted at **www.dxinfocentre.com/tropo_aus.html** – anticipating suitable conditions is now much easier.

Hepburn's maps graphically indi-

If you thought the AIS plot on page 14 was impressive, what about this one! Over 200 vessels have been identified stretching all the way up to and through the Indonesian Archipelago. Comparison of the Hepburn map with the Pilbara's AIS reception coverage shows HTI propagation predictions well confirmed. As vessel movements naturally tend to follow defined routes, the region's shipping lanes and movement intensity can be clearly established.

As we explained in the article in our August issue, you don't need a lot of equipment to receive AIS signals.

cate the likely strength of a region's tropospheric ducting on a ten-point HTI (Hepburn Tropo Index) scale – zero being negligible while ten becomes near "armchair quality".

Dampier's intense late October-early November 10+ HTI predictions indeed correlated closely with the region's noted AIS enhancement.

Given the well-defined tropo AIS coverage, considerable scope for marine-sourced investigations (both commercial and technical) may now arise.

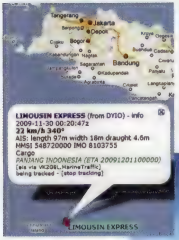
As tropo propagation of higher frequency microwaves can occur, it's even tempting to consider a crack at the 2.4GHz WiFi record – presently a "mere" 382km!

Although FSPL (Free Space Path Losses) increase significantly at such microwave frequencies, it's feasible tropo-enhanced WiFi links could be made using high gain 2.4GHz dishes to give decent EIRP (Effective Isotropic Radiated Power).

After all, AIS signals (originating from ~12W shipboard VHF transmitters) were received over 1000 km away in Dampier with just a simple ¼-wave whip!

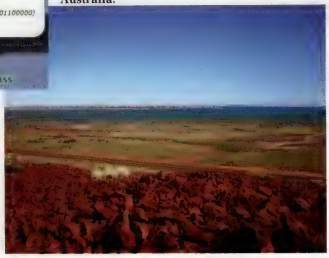
References:

Hosted at: **www.manuka.orcon.net.nz/ais.htm** SC



Here's a new record just set (30 November) by the Dampier AIS station: the "Limousin Express" was detected near Christmas Island, nearly 1500km out in the Indian Ocean. It's just another example of AIS tropo reception.

Looking out over the port of Dampier belies the enormous amount of shipping just over the horizon. It also says nothing about the huge economic benefit to the region, the state and to Australia.



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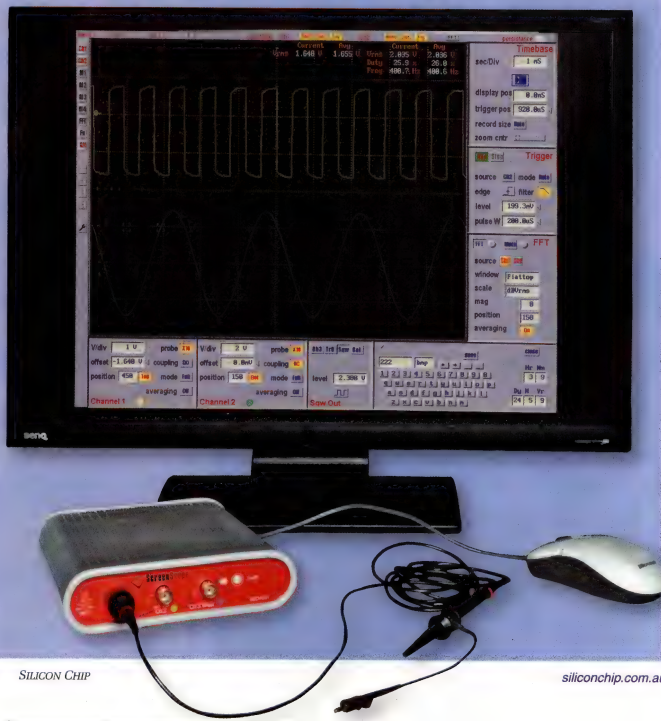
Review by MAURO GRASSI



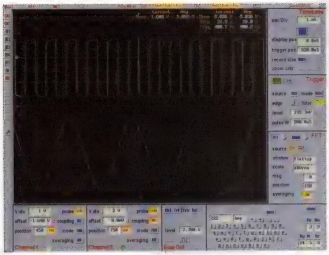


Fig.1: this screen grab shows the two vertical channels displaying a square wave and a sinusoidal wave. In this case, the square wave is the 1.22kHz signal from channel 3. The sinusoidal wave is the output of an external signal generator at 400Hz. Triggering is set on a rising edge of the sinusoidal wave. Note that the trigger point is to the left of the main vertical axis.

Fig.2: a pulse width modulated signal at a frequency of around 520Hz is shown in this screen shot. The duty cycle of the waveform is around 37% (average), as indicated by the text at the top of the display. Automatic measurements can be enabled on a per channel basis and you can display up to three automatic measurements simultaneously.

The ScreenScope SSC-A531 is a digital dual-channel oscilloscope with a bandwidth of 50MHz and a wide range of features including FFT but it has no controls, no knobs and no screen. Instead, you connect your own LCD or CRT colour monitor to provide as big a screen as you want. Add a USB wheel mouse and you can control all scope functions as well as drag and move waveforms on the screen.

AT SILICON CHIP, we are fortunate to have a number of high-performance digital sampling oscilloscopes and one of them, the Agilent MSO7034A, has a large screen which is great for easy viewing. It and other modern digital scopes also have a VGA or XGA output so you can have a much larger display if you want. Realistically though, many technicians simply cannot afford a modern digital scope and they certainly cannot afford one which has a big screen.

But LCD monitors are now quite cheap. You can buy a high-performance LCD 22-inch or 24-inch monitor for a few hundred dollars. What if you could get a cheap scope gadget which fed signals to a cheap large-screen monitor? Wouldn't that be great? No squinting at a tiny screen, trying to glean signal details etc, etc.

The people at Diamond Systems must have had a similar thought process. They have developed and produced the ScreenScope SSC-A531, a 50MHz digital scope in a compact box with only three BNC sockets on the front panel but no knobs. On the back panel it has a 9-pin socket for connection to that nice big monitor. All the smarts are in that compact box – no laptop and scope software are required. What a great concept!

XGA video signal

The SSC-A531 outputs an XGA (1024 x 768 pixels) colour video signal

The ScreenScope is built into a rugged aluminium case with three BNC sockets on the front panel.

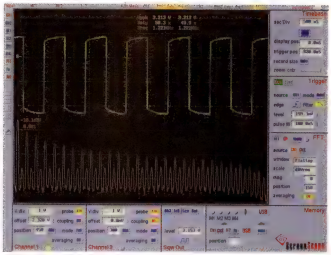


Fig.3: the Fast Fourier Transform shows the frequency components of the square wave applied to channel 1. You can see the peaks corresponding to the odd harmonics of the fundamental frequency (1.22kHz). The square wave measures 3.2V peak-to-peak, as shown in the top area of the display. Note that the display refresh will slow down when the FFT option is selected.

Fig.4: channel 1 shows a square wave at 1.22kHz while channel 2 shows a sinewave at around 400Hz. The result of multiplying the two traces is shown as the MATH trace in red. The MATH trace can also be averaged to reduce noise and automatic measurements displayed at the same time. Both the measurement selected and its running average are superimposed on the display.

as shown in the accompanying screen grabs. Most LCD or CRT monitors would be suitable although the best display would normally be obtained with a native resolution which is precisely XGA. Monitors with higher resolution may possibly stretch the display and this pixel stretching could lead to slightly less than an optimum picture.

We tested the ScreenScope with a widescreen 24-inch BENQ LCD monitor which has a native resolution of 1900 x 1200 pixels and in our case, the display was centred with black stripes on either side (ie, not stretched). The resulting screen display is bright and very easy to read.

As already mentioned, the ScreenScope has no controls on the front panel, although it does have a membrane switch which is the On/Off button. Two of the BNC sockets are the channel 1 and channel 2 vertical scope inputs while the third BNC connector is reserved for an external trigger source or for other functions which we will mention later.

Both 1x and 10x probes can be used and the ScreenScope is supplied with two 100MHz 10x passive probes.

The rear panel has a DC power socket and two USB sockets, one for connecting a 2-button mouse (with click wheel) and the other for connecting a USB flash drive. And there is also the 9-pin port for connecting a video monitor.

A USB flash drive can be used to

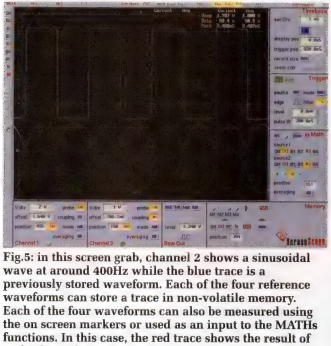


Fig.5: in this screen grab, channel 2 shows a sinusoidal wave at around 400Hz while the blue trace is a previously stored waveform. Each of the four reference waveforms can store a trace in non-volatile memory. Each of the four waveforms can also be measured using the on screen markers or used as an input to the MATHs functions. In this case, the red trace shows the result of multiplying the two traces.

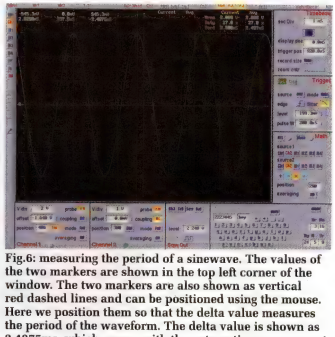


Fig.6: measuring the period of a sinewave. The values of the two markers are shown in the top left corner of the window. The two markers are also shown as vertical red dashed lines and can be positioned using the mouse. Here we position them so that the delta value measures the period of the waveform. The delta value is shown as 2.4875ms, which agrees with the automatic measurement shown.

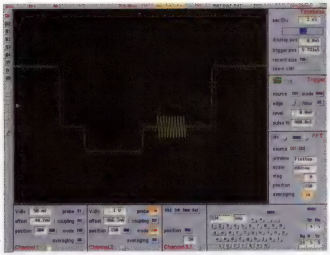


Fig.7: this screen grab shows a PAL video signal with the timebase set to 2µs/div. The line sync pulse occurs about 6µs from the start of the trace.

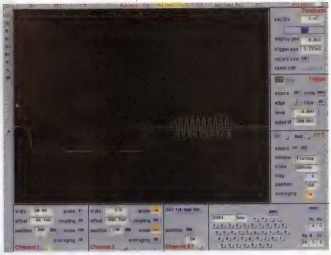


Fig.8: the line sync pulse (which is around 4.7µs long) is followed by the colour burst signal, shown here using a timebase of 1µs/div for greater detail.

store waveforms – more on this later.

When the ScreenScope is turned on, a red LED glows next to the power button. It takes about seven seconds from initially being turned on to display a waveform, which is a shorter boot up time than many standalone oscilloscopes. From this point on, you control all functions via the mouse.

For example, the timebase can be changed by moving the mouse pointer to the panel located in the upper right corner of the display, as seen in Fig.2 where it is shown set to 2ms/div. You can vary the setting using the mouse's click wheel or the left and right buttons. Pressing the left button decreases the value, while pressing the right button increases the value. This works with most of the other controls too.

The timebase can be varied from 3.3ns per division (3.3ns/div) down to an extremely low 1 hour per division. That is much slower than most conventional digital scopes but we should note that timebase settings from 100ms to 1hr/div use the so-called "chart recorder" mode that resembles a data logging mode rather than a standard oscilloscope sweep display.

This means that the samples are displayed as soon as they are acquired rather than after a complete sweep. This is a considerable advantage on very slow timebase settings, as you do not need to wait for the entire sweep to see the waveform, which could otherwise be a long time indeed. At 1hr/div, it would take 10 hours for the trace to make one sweep!

Vertical resolution is fixed at eight bits while the vertical input sensitivity can be varied from 50mV/div up to 10V/div (on a 1x probe).

Display modes

For each of the two channels, the ScreenScope allows you to select whether the trace is shown in "full" or "half" mode. In full mode, the waveform is shown at the full vertical 8-bit resolution, spread over the entire 600 pixels of the display window.

However, because the viewable display is so large, in some cases, depending on the vertical scale setting, this resolution may be too coarse to achieve a good display. In this case, you should use the "half" mode, which effectively doubles the resolution by using the full vertical resolution to occupy only half of the viewable resolution (that is, eight bits for 300 pixels).

Trigger options

The ScreenScope can store more samples than are displayed on the screen at any time. This allows the waveform to be panned and zoomed using the mouse. This is very useful for investigating a waveform around its trigger point. All the usual triggering options, except video, are available.

You can select to trigger on a rising or falling edge or on a positive or negative pulse width from any of the three channels. There is a configurable filter that can be applied to the trigger source to reduce noise and avoid unwanted triggering. This can be configured both as a low-pass filter to reject high frequency noise or as a differentiating filter that computes the gradient of the signal before applying it to the trigger circuit.

The latter is useful for triggering from sharply rising waveforms (which exhibit high gradients) while ignoring low-frequency components.

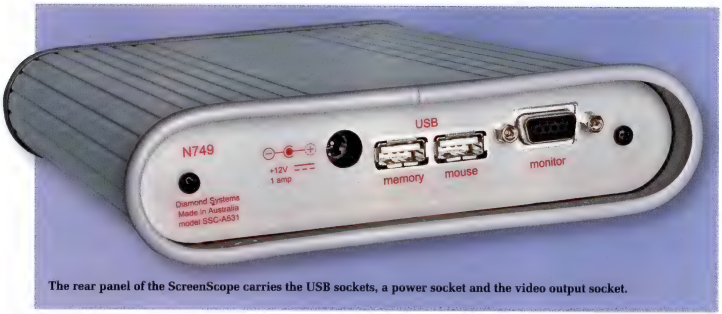
As with most oscilloscopes, the sweep mode can be automatic, triggered or single shot.

MATHs features

While the ability to add or subtract the input channels is more or less

Features At A Glance

Bandwidth:	50MHz real-time sampling
Channels:	2 analog + 1 digital
Sample rate:	240 megasamples (MS) per second
Memory Depth:	4 kilosamples (KS) per channel
Vertical Resolution:	8-bit ADC
Video Output:	1024 x 768 pixels (XGA), 256 colours
Size:	160 (W) x 227 (L) x 42mm (H)
Weight:	0.95kg



The rear panel of the ScreenScope carries the USB sockets, a power socket and the video output socket.

standard on all scopes these days, we did not expect to find the FFT (Fast Fourier Transform) facility which can be applied to channel 1 or channel 2. The FFT resultant trace is shown in red (see Fig.3). The scale can be set to dbV (for an unterminated waveform), dBm 50R (for a 50-ohm termination) or dBm 75R (for a 75-ohm impedance) – note that other impedances are also accounted for. This is simply a time-saving feature with the most common impedance settings.

You can also enable averaging on the FFT channel to smooth out noise in the signal. Other MATHs features allow you to multiply and divide the amplitudes of two traces (see Fig.4 and Fig.5). The two traces can be chosen from among the two analog channel inputs, as well as from any one of four previously stored reference waveforms (see below). Note that when you enable any of the MATHs features, the display update frequency will decrease.

Saving screen grabs & waveforms

ScreenScope allows you to save up to four waveforms in internal non-volatile memory – these are the so-called reference waveforms (see Fig.5). These can be acquired from any of the two analog channels or from the result of the FFT or the arithmetic operations. You can even load a reference waveform from an external USB flash drive.

For extra storage, an external USB flash drive allows you to save many more samples where it can function as a data-logging tool. Note that the data logging to USB may lose samples at very high sampling rates – this is a limitation of the packet size implemented for the USB transfer.

Measurements & markers

ScreenScope can make measurements of the waveforms that are displayed in the upper area of the screen. Measurements include the peak-to-peak voltage, amplitude, RMS voltage, rise time, fall time, duty cycle, frequency, period and positive and negative pulse width.

Up to three measurements from three different groups can be displayed at any one time for both input channels. When selected, the measurements are displayed superimposed on the waveform window in red and white. Both the current reading and its running average are displayed.

The units are auto scaling, meaning they change between mV and V or between µs and ms, say, depending on the measurement.

Two screen markers can be moved around the waveform window using the mouse (see Fig.6). Actually ScreenScope refer to them as markers but they are displayed as red vertical cursors. The X or Y coordinates corresponding to the markers are then shown in the top-left corner of the waveform window, as well as the delta value (the difference between the two markers). This allows you to measure details of a captured waveform.

The markers can be applied to any trace, including both of the input channels and any of the four reference waveforms.

Calibration & probe compensation

The output on channel 3 can be used for probe compensation as well as for calibration. It provides a 1.22kHz square wave for probe compensation. Calibration is also performed using channel 3. You simply connect the output of channel 3 to the analog channel you wish to calibrate using a short BNC cable. The oscilloscope does the rest.

Note that you should run the calibration procedure at least 20 minutes after a cold start to allow for temperature drift. The calibration procedure takes around 10 minutes per channel.

Firmware upgrades to incorporate new features or fix bugs can be downloaded from the manufacturer's website and copied to a USB flash drive. The flash drive is then inserted in the host USB socket in the back of the oscilloscope.

Conclusion

ScreenScope offers a good range of user features with a good bandwidth at low cost – much lower than a stand-alone scope of the same specifications. The ScreenScope SSC-A531 is available from Diamond Systems and costs $A539 (including GST).

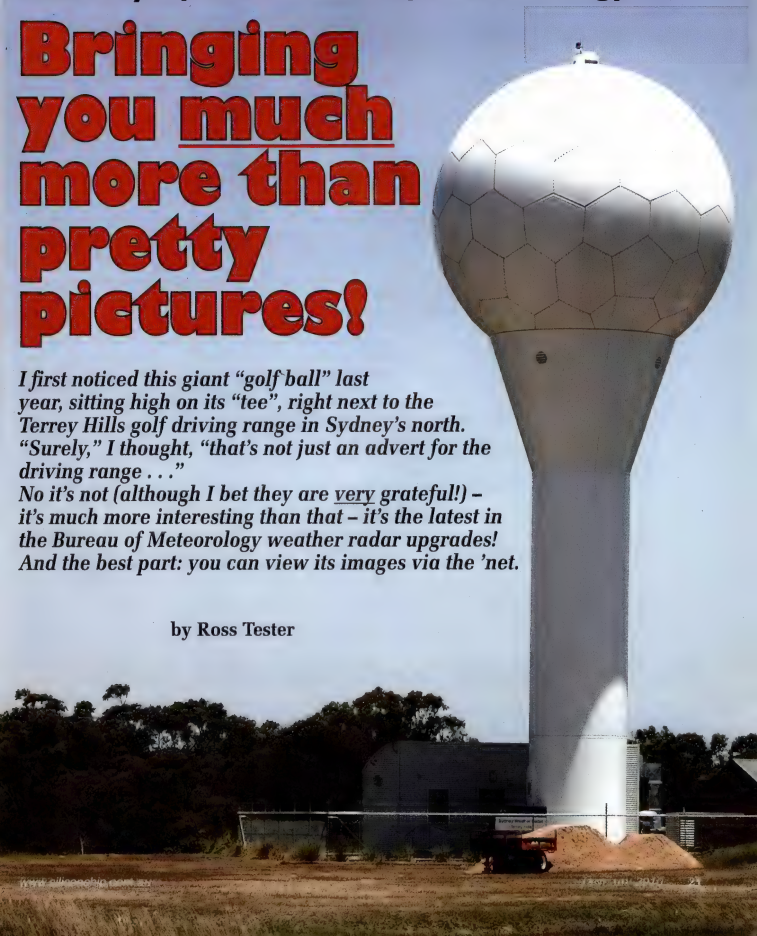
For further information, contact: Diamond Systems, PO Box 105, Hurstbridge, Vic 3099. Phone (03) 9714 8269 or visit their website at **www.screenscopetraces.com** SC

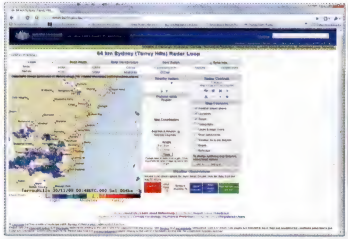
Australia gets new advanced weather radar, courtesy of the Bureau of Meteorology . . .

Bringing you much more than pretty pictures!

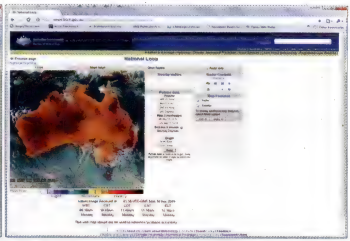
I first noticed this giant "golf ball" last year, sitting high on its "tee", right next to the Terrey Hills golf driving range in Sydney's north. "Surely," I thought, "that's not just an advert for the driving range . . ."
No it's not (although I bet they are very grateful!) – it's much more interesting than that – it's the latest in the Bureau of Meteorology weather radar upgrades! And the best part: you can view its images via the 'net.

by Ross Tester





A typical PC "radar" screen showing approaching rainfall. You can add a lot more map features if you wish.



You can also show the whole of Australia with clouds and rain interpolated from all other radar sites.

Weather forecasting around Australia has become even more accurate and precise with the opening of several new high-resolution Doppler weather radar installations.

With the newest at Laverton (Vic), Mt Stapylton (Brisbane, Qld) and now at Terrey Hills in Sydney's north, each has already proved their $4 million price tags money well spent.

You can become your own weather forecaster by following the weather radar images on the Bureau of Meteorology's website.

The images from the newest technology weather radars cover the last half hour with screens six minutes apart. Older radars have images 10 minutes apart.

There's always a lag of up to about eight minutes – you can look out the window and see that it's raining where you are when the screen tells you that the rain is still approaching (and vice versa). That's mainly because of the incredible amount of computer "number crunching" then the upload times to the net.

You get the choice of 64, 128 and 256km range, plus a 512km "composite" interpolated from other radars. You can also enable or disable a variety of map features, such as locations, roads, topography, etc.

Rainfall is colour-coded by intensity – my experience is that anything yellow or above is getting rather heavy!

You can log on to the Bureau's website (**www.bom.gov.au**) and follow the prompts – the Terrey Hills radar images, for example, are at **www.bom.gov.au/products/IDR714.loop.shtml#skip.**

But there's a lot more than just radar images to look at. The Bureau has a vast array of tools to help the average person understand what the images represent and how to use them.

The Terrey Hills radar

Completed in April last year and commissioned after extensive testing on September 9, it is the fifth of six new high resolution weather radars to come online around the country thanks to the Federal Government's $62.2 million radar upgrade project. In fact, the Government has extended the program with another four high resolution weather radars to be installed as part of the upgrade program.

As far as Sydney is concerned, the Terrey Hills installation effectively replaces the Appin (south of Sydney) weather radar which has been operating since 1992.

As well has having double the resolution of the Appin radar, Terrey Hills also has Doppler capability, which allows the display of wind flows associated with weather systems as well as rainfall intensity.

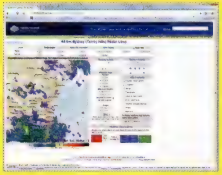
Another problem for the Appin radar was/is that is considered too high above sea level to properly detect low-level rainfall over the Sydney area (as you can see by comparing the images from Appin and Terrey Hills at the same time).

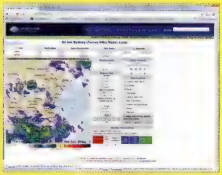
The Appin Radar will continue to operate in the short term. The Bureau is currently examining sites to the south of Sydney for a planned new Wollongong radar.

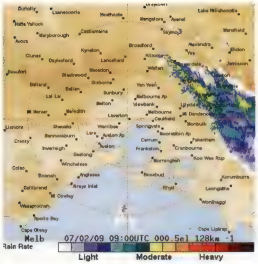
On-going operational benefits of the Terrey Hills weather radar will include:

- Improved short-term forecasts and

The Moving Storm: Monday, November 30 2009







Left: it's not rain – how those on the ground wished it was – these radar images from Melbourne (Laverton) at 09.00 UTC (8pm EDT) on 7 February last year, at the height of the Victorian bushfires, where smoke was dense enough to show up.

Right: the colour-code located underneath each map/image refers to the rainfall intensity. Here's the key – and while it's not absolutely accurate, it's not too bad, either. I've only seen dark brown once – and that was a day that Sydney would rather forget!

Level	Colour		Approx. Rainfall Intensity (mm/hr)
0	clear	Not visible	Under 0.2
1		Off-white	0.5
2		Sky-blue	1.5
3		Light Blue	2.5
4		Blue	4
5		Light Cyan	6
6		Cyan	10
7		Dark Cyan	15
8		Yellow	20
9		Yellow-orange	35
10		Orange	50
11		Orange-red	80
12		Red	120
13		Dark Red	200
14		Maroon	300
15		Dark Brown	over 360

warnings of severe weather, including hail, damaging winds and tornadoes

- Improved radar-derived rainfall rates for use in flood warning applications
- Improved short-term forecasts of rainfall
- Enhanced tracking of the movement and strength of wind changes such as southerly busters, cold fronts and sea breezes.

Because the newest weather radars are Doppler, they can be used to measure speed – of wind, of storm fronts, and so on. Weather radars don't reflect off clouds (the droplets are too small) but they reflect off the raindrops those clouds produce.

Unfortunately, they also sometimes reflect off birds and insects, aircraft and even bats taking to they sky at dusk! Radar close to the coast may also reflect off shipping.

The newest site

The radar site at Terrey Hills (33.701°S, 151.210°E) is 195m above sea level and is approximately 18km north of the Sydney CBD. The radar covers more than a quarter of Australia's population.

Based on detecting echoes at a height of 3000m, the radar has an unobstructed view to the north, south and east.

However, the rough topography of the Great Dividing Range slightly compromises the radar's view to the west.

Even so, high-level (ie upper-atmosphere storm) range extends west to Mudgee and Bathurst, as far north as Bulahdelah and Scone (in the Hunter Valley), and south to Goulburn and Ulladulla (NSW south coast).

An examination of the coverage map will show that these limits overlap the coverage area of other weather radars in the system – which of course is part of the overall Bureau of Meteorology design.

The heart of the installation at Terrey Hills is a Meteor 1500S dedicated S-Band Doppler weather radar, manufactured by AMS-Gematronik. It operates in the 2.8GHz band with a peak power of 750kW.

The 8.5m linear horizontally-polarised dish has a gain of 45dB, 1° half-power beam width and 26dB side lobe suppression. It can scan between 0.2 and 6rpm but normally, the Terrey Hills scan rate is set at 3rpm. It is accurate to 0.1° and is mounted inside the protective fibreglass "radome".

The radar transmitter features a fully solid-state modulator which drives the VKS 8387 klystron tube. The klystron system, together with a coherent receiver, offers up to 20dB improvement in stability and clutter suppression compared to older, coaxial magnetrons.

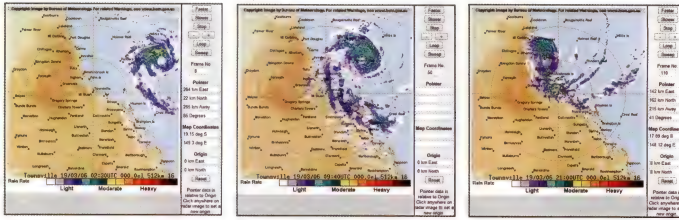
Other advantages of the klystron transmitter included high average and peak power, high gain, high efficiency, longer pulse duration and sufficient control of the waveform and frequency.

The "Golf Tee" tower

The 20m tower, which weighs in at about 60 tonnes, is made up of a bolt cage foundation, base, column, conical sections, a radar "floor" and topped by a 11m diameter fibreglass radome. The tower itself is 3.8m in diameter and the conical section at the top is 7.2m in diameter.

It was manufactured by Melbourne-

As a storm, it was only a tiddler. The colours show the rain rate – only a few patches of red, mostly greens, blues and greys. This half-hour "loop" from 04:18 to 04:48 UTC (3:18 to 3:48pm Sydney time) tracks the path of rain across the city. This one is also slow-moving: storms often move right through the area and out to sea in that 30-minute timeframe.



Remember Tropical Cyclone Larry, which brought so much devestation to North Queensland in March, 2006 (who could forget the price of bananas). Here Larry is being tracked by the Townsville weather radar (265km away) as it develops out in the Coral Sea and then finally comes ashore right over Innisfail. One surprising aspect of these radar images is the lack of rain intensity – not much above moderate. But if you've ever been caught in a cyclone, you'll know it's a tad more!

based Eliot Engineering, who also manufactured the towers at Melbourne and Brisbane.

How it works

Contrary to what you might expect (having seen radar at airports, etc), as well as spinning in the horizontal direction weather radar antennas also move in the vertical direction. From a minimum of 0.5° above the horizontal, each rotation of the "dish" increases by 0.5° to build up a "3D" image.

If this wasn't done, the radar image would effectively be at one particular elevation. And as we all know, rain clouds/storms don't scud along at a single convenient height.

Depending on the type of cloud or storm it could be anywhere from virtual ground level right up to tens of thousands of metres.

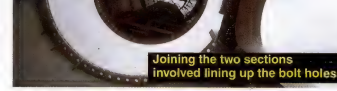
Hence the dish moves to capture the various heights. The hardware and software to control this is quite low level – in fact, a standard 512MB 2GHz PC is used running proprietary "Ravis 1500" software. Radar images are first processed on site by "Aspen DRX" signal processor software.

There is an enormous amount of information contained in the reflected radar images. For example, there's always clutter and false images which need to be analysed and if possible eliminated (although that's not always practical).

And of course, there is the integration of the various radar sweeps to form a single, coherent image. All this requires significant computer grunt, not to mention some pretty smart software.

As a standard tool for the meteorological user, AMS - Gematronik has developed a powerful and versatile software package, fittingly enough

November 2008: The first 5m tower section in place



Joining the two sections involved lining up the bolt holes.

Lowering the 5m pedestal that allows the radar dish to rotate.

It's important that the radar site has an unobstructed view. This semi-fisheye shot is looking towards the west.

called "Rainbow". This offers the integration, processing and distribution of any kind of meteorological data and for remote control of weather radars within a meteorological network.

Warnings

While duty forecasters will always be monitoring their screens at the various meteorological offices (each capital city), much of the information coming in can trigger warnings which the duty forecasters can then act upon – for example, issue warnings to the media regarding approaching storms, prepare for possible floods, and so on.

The duty forecasters' screens will contain a lot more information than radar images but radar is a very important tool in getting the message out to the public about short-term weather.

The highly-skilled operators can identify a lot of varied information from weather radar that the untrained person would probably miss completely – for instance, southerly busters (very common in Sydney in summer), differences in thunderstorm types, hail, rotational super-cells.

While the various BOM weather radar websites are very popular at the best of times, during storms or other weather events usage shoots up virtually exponentially.

Thunderstorm warnings, for example, not only use the information from the weather radars (and other measuring equipment, some at the weather radar site but also located right across the country) and are automatically plotted on maps on the BOM website, with expected direction and intensity.

The software tracks the thunderstorm on radar for a couple of cycles then projects its likely track.

Even the place names are automatically generated and displayed so there can be no doubt in viewer's minds as to location. Again, all this information can be circulated to the mass media for public warnings.

Lightning

One thing that radar does not detect is lightning, basically because there is nothing to reflect the beam back.

However, there are quite precise methods of measuring lightning strike location and intensity but these are not functions the bureau performs.

Instead, private organisations provide this service either in real time or as a delayed report.

Lightning strike measurement is a fascinating subject in itself – SILICON CHIP has featured a couple of articles on the subject, the latest being in the November 1996 issue ("LPATS – Striking a Blow Against Lightning"). SC

February 2009: Installing the 8.5m radar dish onto the pedestal.

March 2009: Placing the last of the radome panels.

benchmark
JANUARY 2010

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Talk to the Techxperts

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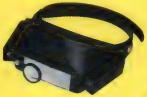

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GPS Car Computer

Pt.1: By Geoff Graham

This project was inspired by requests from a number of readers. Essentially they said that the GPS module was great for obtaining a precise time . . . but could we produce a project that used its full capabilities for use in a vehicle?

This is the result. It is small enough to sit on the dash or mount in the radio-sized (DIN) blank panels that many vehicles have.

It is also relatively simple to construct and uses just a few active components on a single PC board with no other wiring. There is no setup or calibration required – just plug it in and away you go!

It is designed for use in a moving vehicle, where your attention should not be distracted from the road for any longer than is necessary. Therefore data, such as your speed, is displayed in easily-readable 14mm high digits, while a button press will show other data as needed.

You can also set it to automatically step through the data screens for complete hands-off operation.

A key component is the graphic LCD which allowed a great deal of design flexibility. Three fonts are used ranging from a jumbo font to a small detailed font, while some areas also use graphic symbols.

The display uses a green LED backlight, with the brightness automatically changed between day and night settings, which can be easily configured.

An USB interface allows you to plug the device into a laptop for a complete navigation experience with your position accurately pinpointed on a map. The USB interface also allows you upload new firmware and re-program the device without any special hardware.

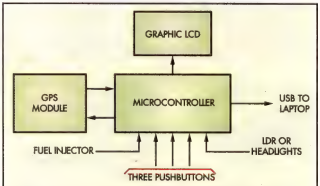


Fig.1: conceptually, the GPS Car Computer is quite simple. The microcontroller takes data from the GPS module, monitors a number of external signals, formats the data for display and sends it to the LCD. While doing this it can also manage communications with your laptop via USB.

Block Diagram

Fig.1 shows a block diagram of the unit. The central item is a 40-pin microcontroller which does most of the work, including receiving data from the GPS module, driving the LCD and communicating via USB.

The GPS module used is the EM-408 which we have used in a number of previous projects. Once every second this transmits your current speed, position, etc as a serial data stream to the microcontroller.

When a complete set of data has been collected the microcontroller will calculate parameters such as the fuel economy and format the data for display. This data is then sent at high speed to the LCD so that the display updates very quickly – in the blink of an eye!

The microcontroller also monitors a number of inputs, the three pushbutton switches, a light dependent resistor (or the car's headlights) for night/day detection and a signal from the fuel injector system used in measuring fuel economy. It also controls the backlight brightness of the LCD and communicates over USB to a laptop.

FEATURES:

- **Digital speedometer**
- **Over-speed alarm**
- **Fuel economy meter**
- **Distance and time to destination**
- **Digital clock with GPS accuracy**
- **Altitude in metres**
- **Heading and compass**
- **Current latitude and longitude**
- **A USB 2.0 interface so that you can use it with your laptop for navigation or uploading firmware changes...**

The only other items of note are two voltage regulators which supply 5V for the microcontroller and 3.3V for the GPS module. The device can be powered from the vehicle 12V battery or from a computer's USB interface.

The main PC board is very small at 123 x 43mm and piggybacks onto the LCD readout – the complete display/PC board stack is about 25mm high. The dimensions were deliberately kept small so that the complete unit could be mounted in many places in addition to sitting on top of the dashboard.

Circuit Details

Fig.3 shows the full circuit diagram of the GPS Car Computer. As discussed before, it is not very complex and is dominated by the microcontroller, a Microchip PIC18F4550. This is mostly concerned with driving the graphic LCD via an 8-bit bus (D0 to D7) and seven control lines.

The LCD is mounted upside down so that the data lines are physically on the bottom of the PC board (viewed from the front) and do not short against the GPS module which must be mounted on top. To accommodate this, the display image is reversed in firmware and the data lines are reversed (D0 on the microcontroller connects to D7 on the LCD, etc).

An additional output (pin 17 or RC2) is used to control the backlight of the LCD. The microcontroller generates a square wave on this pin which, via Q1, rapidly switches the backlight LEDs off and on. By varying the duty cycle of this waveform the microcontroller can smoothly control the backlight brightness from off to full on.

The firmware allows you to set separate levels of the backlight brightness for day and night, determined by a light sensor or the vehicle headlights. When the microcontroller detects a transition between day and night it will change the brightness gradually over a period of about a minute. This is done so that the driver is not distracted by a sudden change in brightness.

The crystal (X1) on pins 13 and 14 provides the main clock. Within the microcontroller the 20MHz crystal frequency is divided by 5 to give 4MHz and then multiplied by 12 in a phase locked loop (PLL) to generate the processor clock of 48MHz. This is further divided by 4 to drive the USB 2.0 interface and also divided by 4096 to generate an interrupt to the CPU every 85µS.

Continuing in a clockwise direction around the circuit diagram, the three pushbuttons go straight to inputs on the microcontroller which are pulled high by internal resistors. As a result a button press causes the input to be pulled low. The firmware switches the pullup resistors off and on as needed, so if you use an oscilloscope on these inputs you will not see a simple DC voltage.

Pin 18 (VUSB) of the microcontroller connects to an internal 3.3V regulator which is used to power the USB interface within the chip. The 220nF capacitor on that pin

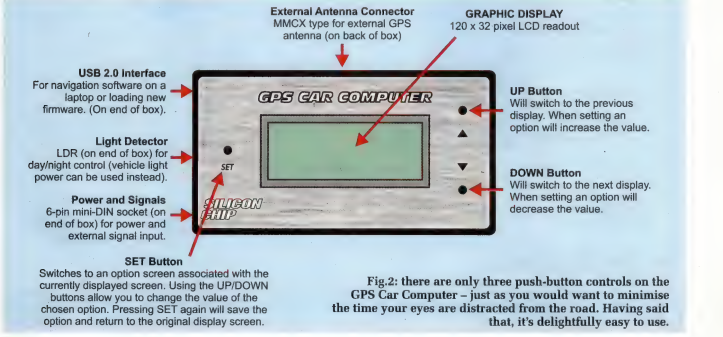


Fig.2: there are only three push-button controls on the GPS Car Computer – just as you would want to minimise the time your eyes are distracted from the road. Having said that, it's delightfully easy to use.

helps suppress ripple and noise in the regulator.

The data lines (D+ and D-) from the USB socket connect directly to pins 24 and 23 respectively of the microcontroller. This is one of the great features of the Microchip microcontrollers; you do not need external resistors, transceivers or any sort of supporting components. Everything to do with the USB connection is taken care of within the chip.

Jumper JP1 is used to prevent a conflict with the USB power source when the GPS Car Computer is permanently powered from a 12V supply. The need for this is explained in the section on assembly options.

GPS Module

The interface to the EM-408 GPS module has some tricks to it that need a little explanation. The signal line from the microcontroller's pin 25 to the module's receive data input (Rx) is simple enough. The microcontroller runs at over 5V while the GPS module runs at 3.3V, so the two resistors are necessary to drop the microcontroller's output voltage to a safe level for the module.

The transmit data from the module to the microcontroller is where the problems occur. The voltage level on the EM-408's transmit line is a little lower than the standard TTL threshold for a high logic level.

This, coupled with noise and temperature variations will cause intermittent errors in the data stream as read by the microcontroller.

If you refer to Fig.4 you can see that we overcome this

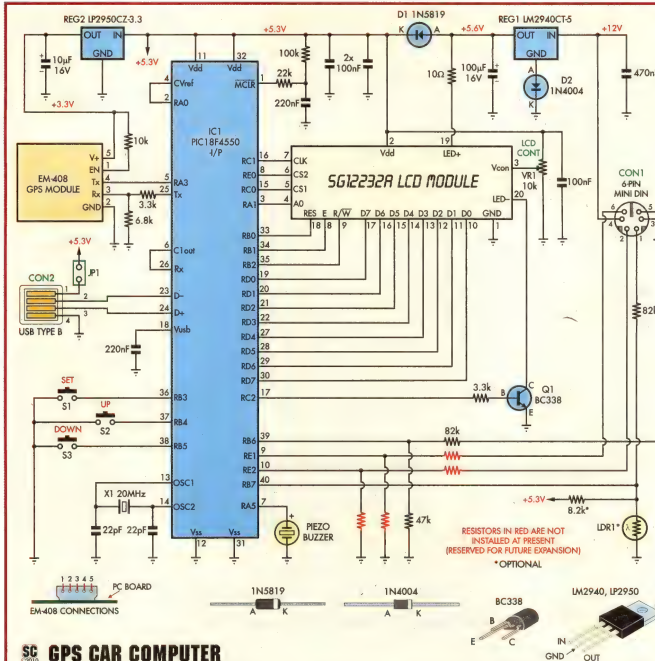


Fig.3: the full schematic for the GPS Display. It is dominated by the microcontroller which is mostly concerned with receiving data from the GPS module and driving the LCD. The only other items of note are two regulators which provide 5.3V and 3.3V.

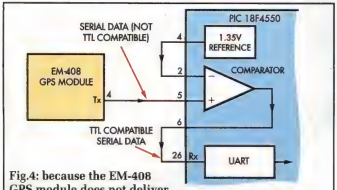


Fig.4: because the EM-408 GPS module does not deliver standard TTL voltage levels we must convert the signal. This is done by a comparator which compares the signal to a 1.35V reference, both of which are integrated in the microcontroller. The output of the comparator is a TTL compatible signal which is fed to the UART, also within the microcontroller.

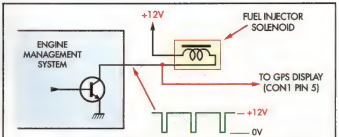


Fig.5: a simplified diagram of the fuel injector control in a standard petrol engine. The positive lead of the injector is at 12V and the engine management pulls the negative lead to zero potential to open the solenoid and inject fuel into the inlet manifold. It is this signal that you should feed to the GPS Car Computer.

issue by feeding the transmit data to the non-inverting input of an analog comparator circuit within the microcontroller (pin 5 or RA3).

The microcontroller is also set up to generate a 1.35V reference voltage which is available on pin 4 (CVREF). This in turn is connected to the inverting input of the comparator on pin 2 (RA0).

The result is that the transmit data signal from the EM-408 is compared to 1.35V and the clean, TTL-compatible, output is available on pin 6 (C1OUT), which is connected to the input to the serial data receiver (UART) at pin 26 (Rx).

Power Supply

The main power is derived from the vehicle's 12V battery present at pin 4 of the DIN input/output connector. REG1 is a 5V linear regulator designed for automotive use so it can withstand large voltage spikes, momentay reversal of the input voltage and other abuses that are common in the auto environment.

With the backlight turned on full, the regulator will dissipate almost 1W so it is mounted on a small heatsink.

Silicon diode D2 in the common leg of the regulator serves to raise its output to 5.6V, then the 1N5819 Schottky diode in series with the output (D1) will drop about 0.3V resulting in an output of about 5.3V for the LCD and microcontroller.

This is done for a number of reasons. First, diode D1 serves to isolate the main power supply if the GPS Car Computer Display is plugged into a USB port. If D1 was not present, the 5V supply from the USB port would also try to drive the output pin of the voltage regulator, resulting in an excessive current from the USB source.

The second feature of this circuit is that it provides a 5.3V supply to the LCD. This is needed because the contrast of the LCD is controlled by the voltage on pin 3 (Vo) with reference to the voltage on pin 2 (Vdd). For normal contrast the voltage on pin 3 should be about -4.9V to -5.1V compared to pin 2 - although this varies with temperature and manufacturing tolerances.

Without going into the subtle details, this means that either the supply voltage on pin 2 of the LCD must be noticeably higher than 5.1V or we must be prepared to

The GPS Car Computer mounts on the Jiffy Box lid, which becomes the base . . . with the LCD readout showing through a cutout in the base . . . which becomes the front panel.

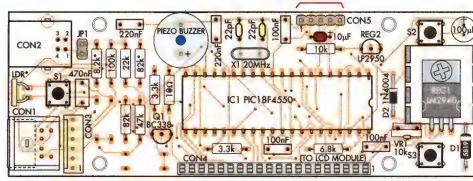


Fig.6: component overlay for the main PC board. Components marked with an asterisk (*) are optional – their use is explained in the text. The GPS module "plugs into" the header socket, CON5, while the LCD readout module similarly plugs into the longer socket, CON4.

supply a negative voltage to pin 3 to get a proper level of contrast. Our approach of using D1 and D2 to give 5.3V is much simpler than generating a negative voltage.

The final benefit of this power supply design is that we can use the 5.6V (via a 10Ω current limiting resistor) for driving the backlight LEDs.

Given the various voltage drops involved (about 3.6V across the LEDs and 0.7V across Q1) it is much easier to get full brightness from a supply that is a bit higher than 5V.

This arrangement also means that the backlight is automatically disabled when a USB power source is used – handy because the USB interface on your computer would be overloaded if the backlight was enabled.

The second voltage regulator, REG2, is a 3.3V device that supplies the GPS module. It has a low dropout voltage, so it is happy with the 2V voltage differential between its input and output and it comes in a TO92 package, which is convenient as there is not much space on our PC board.

External connections

All external connections are made through CON1, a 6 pin mini DIN connector. Ground and 12V are on pins 3 and 4 (respectively) of the connector. An external input from the vehicle's headlight's circuit can be wired to pin 1 to control the day/night backlight brightness (more on this in the section on assembly options).

Pin 5 of the connector can be wired to a fuel injector solenoid if you want to implement the fuel economy meter function. The 82K and 47K resistors serve to drop the vehicle voltage levels to 5V for the microcontroller.

There are also two spare connections (pins 6 and 2) which can be connected to pins 9 and 10 of the microcontroller. These are unused and available for future use. They can be set by the firmware to be digital inputs, digital outputs or analog inputs.

Future firmware updates could use these to measure voltages (eg, battery voltage or sensor outputs), detect digital inputs (eg, switch closure or tachometer output) or set them to be an output to control something.

PC board

The GPS Car Computer is built on a single PC board coded 05101101. The PC board is double sided and uses plated-through holes thereby allowing us to keep the size small.

This type of PC board is actually easier to assemble than the single sided version commonly used. This is because the board is coated in a varnish (called solder resist) which protects tracks and areas that should not be soldered. It also has the position and values of the components printed on the top side of the board which means that assembly is mostly an exercise in following the diagrams.

When soldering this type of board you should observe normal good soldering practice. Use a temperature controlled iron set to about 360°C with a fine tip (0.8mm chisel is good). Use fine resin-cored solder (0.8mm or less) and don't hold the iron on a joint for more than three or four seconds.

The use of plated-through holes means that you don't need to install links but it does mean that it is difficult to remove a component after it has been soldered in. So, take care before you apply the soldering iron – check that the component is the right value and orientated correctly.

The best way to remove a component from a board with plated through holes is to cut its leads close to the body, then pull the leads out with pliers while applying heat to the solder pad. You can then use de-soldering braid or a solder sucker to remove the excess solder from the pad and hole.

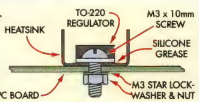


Fig.7: the 5V regulator can dissipate up to 1W so it must be mounted on a heatsink. A smear of heat transfer compound must be applied between the regulator and the heatsink. Before tightening the bolt check that the heatsink clears the nearby solder pads. Only after you have tightened the nut and bolt should you solder the regulator's leads to the PC board.

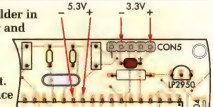
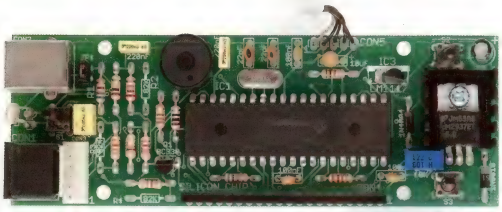


Fig.8: before you solder in the microcontroller and connect the GPS module you should check that these voltages are present. Both have a tolerance of ±150mV. If you cannot measure the correct voltages you should check D1, D2, IC2, IC3 and the power connection.



Here's a photo of the GPS Car Computer to match the overlay at left. In this case, the LDR option is used to control the day/night function. This an early prototype and the silk screen legend will be slightly different in the final board.

If you want to make your own PC board, PDF and (zipped) EPS files can be downloaded from the SILICON CHIP website.

However, given the fact that it is a double-sided board AND has plated-through holes, home fabrication is a lot more difficult than standard (single-sided) boards.

Gerber format design files for the board, (used by most PCB fabricators) have been uploaded to BatchPCB and you can order it from them by following this link: **http://tinyurl.com/ybulgcy**. Many other PCB fabricators will also make the board for you and **http://opencircuits.com/PCB_Manufacturers** lists a large number of these companies. Of course, kit suppliers will include the board as part of the kit.

Assembly options

Before you start soldering there are a few of assembly options that you need to consider.

The first is the control of the backlight brightness. The microcontroller determines if it is day or night by the voltage on pin 40 (RB7). When it is above about 1.4V it is night; less than that it is daytime.

By rearranging the components on this input you can use a light dependent resistor (LDR) or the car's headlight circuit to switch between the night and day brightness levels. The following table lists the components used:

	LDR Control	Headlight Control
LDR	Install LDR	47kΩ resistor
R1	8.2kΩ resistor	Leave Empty
R2	Leave Empty	82kΩ resistor

Note that for headlight control the 47kΩ resistor is installed vertically in the position marked for the LDR.

You also need to decide how you will wire up the power and other leads going to the mini DIN plug. If you are installing the GPS Car Computer permanently you should connect the negative to the chassis and the positive power lead to a spare position in the fuse panel (if there is one) with a 500mA fuse.

It may be easier to connect to a permanent 12V source and wire via an inline 3AG fuseholder with fuse.

Refer to the Features Panel later in this article for the connection of power and other signals to the DIN connector. If you have decided on headlight brightness control you should wire pin 1 of the DIN connector to the vehicle wiring so that the voltage is at 12V when the headlights are turned on.

A connection between pin 5 and a fuel injector is also necessary if you want to use the fuel economy feature.

Fig.6 shows a typical circuit used in a modern car. You need to locate a negative solenoid lead and connect to that.

The crude method would be to pierce the insulation of the wiring at the solenoid in the engine bay. This would expose the wire to corrosion and other dangers.

A more elegant and reliable method would be to locate the engine management unit, normally behind the firewall in the passenger compartment and connect to the appropriate lead there.

If you need to move the GPS Car Computer around, the best approach would be to wire the power leads to a cigarette lighter style plug with the positive power lead connected to the tip and the negative lead to the side wings. Most of

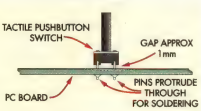


Fig.9: the tactile switches must sit 1mm above the PC board so that the actuating rod will protrude far enough through the front panel. This spacing is achieved by making sure that the switch leads only protrude by a fraction of a millimetre on the underside of the PC board.

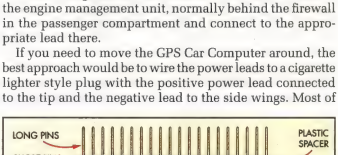


Fig.10: the LCD has 20 pins which plug into the socket on the main PC board. Insert the long pins of the pin header from the underside of the display so that the plastic spacer is flush with the underside. Solder the pins on the top, lever off the plastic spacer and trim the pins on the top of the LCD board.

Here's the partially assembled connector on the LCD. Note that the plastic spacer is on the underside with the long pins running up through the LCD board. The pins have been soldered on top.

This photo shows how to remove the plastic spacer on the underside of the display board using a small screwdriver. You must remove the spacer so that the LCD can snugly mate with the main PC board. The pins on top of the board have already been trimmed. (Refer also to Fig.10).

these connectors have a fuse in the body of the connector but if not, you should insert an in-line fuse holder fitted with a 500mA fuse.

Another option for you to consider is jumper JP1, which is used to isolate the USB 5V supply. Normally this is left in place so that you can power the unit from either USB or 12V sources. You cannot use both simultaneously as this would place 5.3V from the GPS Car Computer on the USB 5V line from your computer, possibly causing damage.

However, in some cases you might want to permanently wire the unit to 12V but still need to connect it to a computer via USB. To cover this eventuality JP1 is provided. When the jumper is removed, the USB cannot power the device, thereby removing any possible conflict.

Construction

Start assembly by soldering the 20-pin socket for the LCD to the PC board. Ensure that it sits fully flush with the PC board before you start soldering.

The reason for starting with this socket is that it allows you to temporarily place the LCD display on top of this socket while positioning the other components.

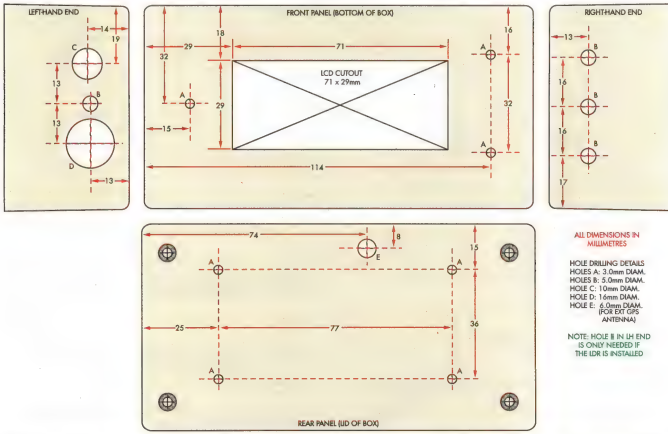


Fig.12: the drill holes and cutout required for the front panel, left and right ends and the box lid (which becomes the base). This diagram is reproduced at 80% – photocopy at 125% so that it can be used as a template. The centre hole in the left-hand end is only necessary if the LDR is installed. The holes in the right-hand end provide ventilation for the 5V regulator – accuracy is not so important in positioning these holes.

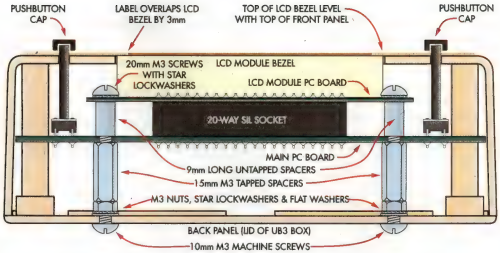


Fig.11: this shows how the main PC board and LCD are joined together and mounted in the UB3 jiffy box. It is important that the actuators of the tactile switches protrude far enough that the caps will fit without touching the front panel. It is also important that the LCD bezel is flush with the outside surface of the front panel.

This is important as there is limited clearance (6 to 8mm) between the main PC board and the underside of the LCD display and you need to be sure that the components on the main PC board do not foul the LCD board before you solder them in.

This particularly applies to the buzzer and trimpot, both of which tend to have extra plastic on their underside. You should cut this away with a sharp knife and make sure that the body of the component sits flush on the PC board and the top clears the LCD above.

Other components that you need to watch out for include the transistor (Q1), the 3.3V regulator (REG2) and the 10µF capacitor. For now, continue with the low profile components such as resistors and diodes and then move on to the taller components. At this stage, do not solder in the microcontroller or the push button switches.

Note that resistors R3, R4, R5 and R6 are marked on the PC board but not installed as they are reserved for future expansion. Be careful with D1 and D2 as they look alike. The same applies to Q1 (the transistor) and REG1 (the regulator), both are in TO-92 packages and can easily be confused.

When soldering in the crystal (X1) ensure that it sits a millimetre or two above the PC board so that there is no danger of the metal case shorting the connecting pads underneath.

The LM2940 regulator (REG1) sits on top of a small heatsink as shown in Fig 7. Refer to this diagram for assembly instructions. Before screwing down the regulator check that the heatsink does not touch the solder pads on either side of the heatsink. The spacing is very close here but the heatsink can be slid around to ensure that it has adequate clearance.

Once this is correct you can tighten the nut and bolt. Finally solder the regulator's leads – this is left to last so that the solder joint is not stressed.

The PC board has provision for an extra connector (CON3) which also can be seen in photographs of the prototype. Ignore this as it is intended for use with an In Circuit Debugger used only during software development.

Quick Test

With all components in place (except the microcontroller, switches, GPS and LCD) we can make a quick test to ensure that the voltages are correct.

With the power/signal cable plugged into the mini DIN socket and the power turned on you should be able to measure about 5.3V between pins 11 and 12 of the microcontroller. Between pins 2 and 5 of the GPS connector (CON5) you should be able to measure 3.3V. Both could vary by plus or minus 150mV.

Refer to Fig.8 for the measurement points. If you cannot measure the correct voltages you should check D1, D2, REG1,

Loading New Firmware

The GPS Display includes the facility to reprogram itself over the USB, this is sometimes called "flashing". You don't need any programming hardware and it uses free software. Full instructions will be included with any updates but the following will give you the flavour of how it works.

To place the device into programming mode you hold down the Set button while you plug it into a USB port on your computer.

This causes the GPS Display to masquerade as a Microchip PICDEM FS USB board and, as far as your computer is concerned, this is exactly what it is. This small deception allows us to use software developed by Microchip to upload new firmware to their own products – much easier than developing our own.

Your computer will then ask for a device driver for the PICDEM board. This is different from the virtual serial port driver used to receive GPS data from the GPS Display and will be included with any updates or can be downloaded from the Microchip web site.

When the device driver has finished loading you can run the programming software provided by Microchip for their PICDEM FS USB board. This allows you to load the HEX file and reprogram the device, which takes only 20 seconds or so. You then unplug the USB cable and when you restart your GPS Display it will be running the new firmware.

You don't have to worry about a power failure or accidently unplugging something while it is programming. The programming code will not be affected if something does goes wrong, so you can always restart and try again or reload your original firmware.

REG2 and the power connection.

Final PC board assembly

Next you should install the microcontroller. This must be first programmed with the file 0510110A.hex (available for download from the SILICON CHIP website) using a normal PIC programmer.

When handling the microcontroller and LCD you should take the standard precautions against electro static discharge (ESD) which could zap these devices. This means making sure that your work surface, your soldering iron and you are all grounded.

As there is not enough clearance between the PC board and the LCD for an IC socket, the microcontroller must be directly soldered to the PC board. Normally you would need to remove it for reprogramming but as you can upload new firmware by USB, this is not a concern.

However, once you have soldered the microcontroller you will not be able to remove it without destroying it. So, please read the next two paragraphs carefully.

Pin 1 of the microcontroller is clearly marked on the PC board and is the top right hand pin when the PC board is viewed from the front. This must be matched to the dimple marking pin 1 on the IC's body. This means that the microcontroller is installed upside down compared to the other components and the silk screen printing on the board.

Before you apply the soldering iron, make sure that the part number printed on the chip is inverted compared to the printing on the PC board.

We understand that Altronics will be producing a kit with a machine cut front panel which will make construction much easier. This will also allow each button cap to sit within a hole in the front panel and consequently there will be more space between the LCD and PC board. The main advantage of this is that an IC socket (supplied with the kit) can be used for IC1 and you do not need to panic over permanently soldering it in.

When you have finished with the microcontroller you can install the three push button switches. These have been left to last because they can be easily damaged if the actuating rod is accidently forced too far to the side during assembly of the board.

As illustrated in Fig.9 the body of

GPS Car Computer - Features Summary

Automatic Scan

Simultaneously pressing both the Up and Down buttons will set auto scan. In this mode the unit will step to the next screen every three seconds. Pressing either Up or Down will terminate auto scan.

The data displayed can be configured as described below.

Show/Hide Display Screens

Holding down the Up button while applying power will enter a special mode to configure what screens will be displayed or hidden.

Repeatedly pressing Set will select:

- Show (ie, the screen will always be displayed).
- Hidden when Auto Scan is operating, otherwise shown.
- Hidden Always. This is useful if, for example, the Fuel Economy Meter is not being used – it can then be hidden to reduce the visual clutter.

Press Up or Down to move to the next screen to be configured. Remove power to exit this mode.

USB 2.0 Interface

The GPS Display creates a virtual serial port over USB and you can use this to connect to your laptop to show the GPS output, plot your location on moving maps and other functions using free and paid software.

You must load the SILICON CHIP Serial Device Driver on to your PC.

Firmware Updates

By holding down the Set button when plugging into a USB port the GPS Display will accept firmware updates delivered via USB. Programming hardware is not required.

Low Signal

In a low signal situation or when first turned on the GPS Display will display a message and a count of the number of satellites found at that time.

Pressing the Set button will show the Current Signal Levels screen described on the next page.

Full Reset

Pressing the Down button for a couple of seconds while applying power will reset the GPS module and all configurable parameters to the factory/design defaults.

Automatic Brightness Control

The brightness of the LCD backlight can be configured separately for day and night. Control of day/night can be from the vehicle headlights or from a light dependent resistor (LDR).

When switching from day and night the brightness is slowly changed over a minute or so to avoid distracting the driver.

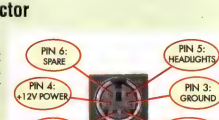
Power and Signal Connector

Pin 3 is ground

Pin 4 is +12V power input

Pin 5 is the fuel injector input. Connect to the negative wire of a fuel injector (this is pulled to ground when the injector solenoid is activated).

Pin 1 is the vehicle headlights input. It will control the day/night brightness of the backlight. This input is optional and is disabled if a light dependent resistor is used.



Pins 2 and 6 are spare input/output lines for future enhancement. In this version they are left unconnected.

GPS Car Computer – Readout Summary

All data is updated once a second. The currently displayed screen and all settings are saved in non-volatile memory and recalled on power up.

Digital Clock

Shows the current time in 12 hour (AM/PM) format. The seconds are shown in the bottom right. The time is derived from the GPS signal and is accurate to within 100mS (ie, any error is undetectable to a human observer).

Pressing the Set button will allow adjustment of the time in steps of half an hour (ie, this sets the time zone – the exact time is always derived from the GPS satellites).

Digital Speedometer with Over-Speed Alarm

The digital speedometer will display your speed up to 250km/h. The current setting of the over speed alarm is shown in the bottom right. An audible alarm (two beeps) will sound when this speed is exceeded and the speedo display will switch to reverse video. Built in hysteresis prevents it from continuously beeping if you stay near this speed.

The Set button will change the threshold or completely turn it off when set to zero.

Fuel Economy Meter

The length of the black bar shows the relative fuel consumption for the distance travelled (equivalent to litres per 100km). The longer the bar, the higher the fuel consumption so you would normally adjust your driving to keep the bar as short as possible.

The graph is not calibrated but the sensitivity (ie, full scale) can be adjusted by pressing the Set button. This allows you to adjust it to suit different vehicles.

Distance and Time to a Destination

This display will count down the distance and time (in hours and minutes) to a destination. The time is based on your average speed over the last ten minutes, so if you get onto a slow road the time to your destination will increase accordingly. This display is reasonably accurate; the error is about one kilometre in 100.

Press the Set button to setup the initial distance to the destination.

Heading, Compass and Altitude

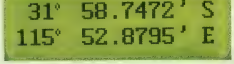
The number on the left is the current heading (direction of the vehicle) in degrees. The needle can show either the heading or point to the north – this is configured by pressing the Set button. The numeric reading will always show the heading.

Your current altitude in metres is shown on the right of the screen.

Latitude and Longitude

Your current latitude and longitude. This is shown as degrees, minutes and fraction of a minute and updates continuously as you drive.

This is accurate to within a few metres depending on the number of satellites that can be found in the sky. This information (and much more) can be sent to your laptop via USB for use by navigation and mapping software.



Current Signal Levels

Shows how many satellites should be in the sky and the number that is currently being used by the GPS module. The bar graph shows the signal level of every satellite that can be detected. The module will not use a satellite if its signal level is below a threshold.

By pressing the Set button you can adjust the backlight brightness for day and night conditions. Day/Night is determined by a light sensor or your car's headlights.

the switches must sit 1mm above the PC board. This is necessary so that the actuating rod will protrude far enough through the front panel. This spacing is easily achieved by making sure that the switch leads only protrude by a fraction of a millimetre on the underside of the PC board before soldering.

The next assembly step is the connecting pins on the LCD. Start by inserting the long pins of the 20 way pin header strip through the matching holes on the LCD from the bottom. The plastic spacer should be flush on the underside of the display's PC board and the shorter pins underneath. See Fig 10.

Solder the pins on the top of the board while ensuring that the spacer underneath remains flush with the board. Then remove the plastic spacer leaving just the pins. This is best done with a fine screwdriver – lever down one end of the spacer by a few millimetres, then the other end followed by the middle. After repeating this a few times the plastic spacer will slide off the pins.

The GPS module is supplied with a cable with identical connectors on each end. Cut off one of the connectors, bare the wires and solder to the pads marked CON5. The grey wire goes to pad 1 which is marked accordingly (the left hand pad when viewing the board from the top). The other wires should be soldered in the same sequence as they emerge from the connector.

As a final check, closely inspect the board with a high power magnifying glass. Carefully check every solder joint for blobs, shorts or poor joints.

You can now plug the LCD and GPS into the PC board. When you apply 12V power your GPS Car Computer should immediately start by showing the firmware version followed by a message indicating that it is searching for satellites.

You will probably have to adjust the 10kΩ trimpot to get an image on the display and then continue adjusting it for a good contrast. Consult the troubleshooting section if you run into problems.

Parts List – GPS Car Computer

1 PC board, code 05101101, 140mm x 57mm
1 EM-408 GPS module manufactured by GlobalSat Technology (available from **www.altronics.com.au**)
1 SG12232A 122 x 32 dot matrix LCD (Altronics Z7052)
1 20MHz low profile crystal (X1)
1 buzzer – sealed mini PC board type, high output (Altronics S6105)
1 light dependent resistor, 10kΩ to 1MΩ (Altronics Z1621) *
3 tactile switches with 22mm actuating shaft (Altronics S1119)
3 button caps 7.5mm diameter (Altronics S1482)
1 mini DIN socket, 6 pin, PC board mounting
1 mini DIN plug, 6-pin
1 B-type USB socket, PC board mounting
1 2-pin header
1 20-pin header
1 20-way header socket, single row (8mm high socket base)
1 U-style micro heatsink for TO-220 (19 x 19 x 9.5mm)
1 UB3 jiffy box (130 x 67 x 43 mm)
4 15mm metal M3 tapped spacer
4 9mm metal M3 untapped spacer
4 20mm M3 bolt
5 10mm M3 bolt
9 M3 Star washer
4 M3 flat washer
5 M3 nut

Semiconductors

1 PIC18F4550-I/P microcontroller (IC1) programmed with 0510110A.hex
1 LM2940CT-5 or LM2938ET-5.0 TO-220 5V voltage regulator (REG1)
1 LP2950CZ-3.3 TO-92 3.3V voltage regulator (REG2)
1 BC338 transistor (Q1)
1 1N4004 diode (D1)
1 1N5819 Schottky diode (D2)

Capacitors

1 100µF 16V electrolytic (105°C rating)
1 10µF 16V tantalum
1 470nF MKT (code 470n or 0.47µF)
2 220nF MKT (code 220n or 0.22µF)
3 100nF monolithic (code 100n or 0.1µF)
2 22pF ceramic (code 22p)

Resistors (0.25W 5%)

1 100kΩ 2 82kΩ * 2 47kΩ * 1 22kΩ 1 10kΩ
1 8.2kΩ * 1 6.8kΩ 2 3.3kΩ 1 10Ω
1 10kΩ trimpot, vertical mount front adjust

* = Optional – see text

The housing

The combined PC board and LCD is 123mm wide, 44mm high and about 25mm deep when viewed from the front. This means that it can be mounted in a standard car radio sized cut out in the dashboard. Many vehicles have this and are intended for holding small items. The PC board and LCD will even fit in the smaller radio slot found in newer vehicles. When mounted in this way and with a suitable front panel the GPS Car Computer appears to be part of the vehicle's instrumentation.

In this type of installation you will probably have to either extend the leads to the GPS module so that it can be moved to a more sensitive position in the vehicle or purchase and attach an external antenna. The antenna connector on the GPS module is an MMCX type and you should easily find a suitable antenna on the Internet (just google for "GPS antenna MMCX"). Getting a good signal level is very much dependent on the design of the vehicle and the position of the GPS Car Computer, so experimentation will be the order of the day.

We decided to mount our prototype in a standard UB3 "jiffy box" so that it could be portable. The stacked PC board and LCD are mounted on the lid of the box, which becomes the back panel as shown in Fig.11. When the complete assembly is slid into the box the LCD bezel and the shafts of the push buttons will protrude through the base of the box (which becomes the front) as also shown in this diagram, the result is a neat appearance without visible screws.

The LCD bezel should protrude through the front panel so that its front face is flush with the box's outer surface. This means that there will be no need for a window or front glass for the LCD and the front panel label will cover any

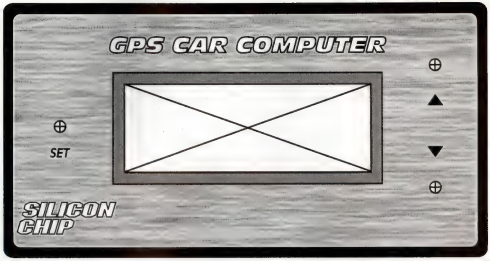


Fig.13: front panel artwork for the GPS Car Computer, reproduced same size, ready for photocopying as described in the text. This can also be downloaded from siliconchip.com.au.

roughness in the cut out. To get this flush appearance you should use the spacers, washers and nuts as illustrated in Fig.11. If your result is not flush (due to tolerances in the hardware) you may need to add or remove some washers.

To prepare the box you should drill and cut holes as illustrated in Fig.12.

These diagrams are reproduced at 80% so if you photocopy them at 125% they can be used as direct templates for positioning the holes and cutout. If you have purchased the Altronics kit you should follow their instructions as their box will be already prepared and will use a slightly different sequence of spacers and mounting hardware for the PC board/LCD.

To finish the assembly you should copy the front panel design in Fig.13 onto heavy-duty adhesive-backed paper (Avery 936067 is a good choice) and then either hot laminate it or cover the printed surface with adhesive backed clear plastic of the type used to cover books. Then razor cut this paper/plastic sandwich around the edges.

When you cut out the centre of the label for the LCD you will notice that it is a little smaller than the LCD bezel. This is deliberate, as shown in Fig.11 the label is designed to overlap the LCD display bezel by a few millimetres. This hides any roughness in the cutout in the front panel and gives a clean, professional finish. Finally, peel off the backing paper from the label and attach to the front panel.

The GPS module sits horizontally on top of the PC board and LCD boards with its antenna (the brown/silver assembly on the top) pointing to the sky. This is its most sensitive orientation.

To make space for the module you need to use a sharp knife to remove the centre two plastic ribs on the top inside of the box. The module should then sit with its external antenna connector (the gold coloured connector) poking through the hole in the back panel and held in place by the surrounding box and PC board/LCD. If the module rattles around inside the enclosure you will have to attach padding of some type to keep it still.

Troubleshooting

With only a few active components in this project it should be easy to track down any faults. Firstly, check the two supply voltages as described earlier as nothing much will happen if they are not correct.

Next, check the microcontroller. This is best done by measuring the voltage on pin 4 which should be between 1.2V and 1.5V. This voltage is created by the internal voltage reference and implies that the firmware is running, has enabled the reference and configured it for the correct voltage. In other words, it means that the microcontroller is perfectly OK and running its program.

In the absence of this voltage, use an oscilloscope to check for a 20MHz sinewave at pins 13 and 14, indicating that the main clock is present. Also check the soldering around the microcontroller for bridges, non soldered joints, etc.

If the microcontroller is working the next thing to check is that the pushbuttons are OK. Use a multimeter to check that the switches are open when not pressed and near zero ohms when pressed.

If a button is stuck down it will cause the unit to go into one of several special modes when power is applied and that may trick you into thinking that the whole unit is not working.

If the actuating arm of a switch is pushed too far to the side this can also cause the switch to close. This can happen if your drilling of the front panel is not accurate.

Next is the LCD. First check the voltage on pin 3 of the LCD (Vo), it should be under 0.5V. This voltage is controlled by the 10kΩ trimpot (contrast) and if not correctly adjusted the display will appear blank.

The microcontroller only sends data to the LCD and does not expect any response. So, even with the LCD removed or faulty, you should still see signals on the data lines to the LCD. If the LCD is blank or showing rubbish the only things that you can do is check that it is plugged in correctly and that there are no solder bridges on the connector.

With the microcontroller running and the LCD showing the startup message the only other fault would be with the GPS module. The microcontroller will display an error message if the module is not connected or running, so that type of fault should be obvious.

The GPS Car Computer could also sit for a long time with the LCD showing a message indicating that it is searching for satellites. This indicates that the GPS module cannot get a signal and moving the unit outside or near a window should correct that. While it is searching you can press the Set button to get the Signal Levels display – this will show you how many satellites can be seen and their signal levels.

Assuming all is well, we're ready to move into some of the more esoteric aspects of operating the GPS Car Computer but alas, space has beaten us so that will have to wait until next month.

However, as we said earlier, it really is very simple and quite intuitive to operate, so between now and February you'll have a good opportunity to play with it yourself and find out many of the good things it can do.

We've even given you a head start with the various LCD readout screens shown earlier! SC

Choosing a Microcontroller

Readers might be interested in the background of why we chose a PIC18F4550 microcontroller for this project.

Originally the design started with the Microchip PIC16F877A. This has been around in various incarnations for at least 10 years (a long time in semiconductor circles) and has long been the chip of choice when large pin counts have been required. However, during development we ran into a problem with its limited RAM.

Searching through the Microchip catalog we found the PIC18F4550. This is a much more modern chip which has 2048 bytes of RAM – plenty for our requirements. As a bonus it also had four times the program memory, ran four times faster than the venerable PIC16F877A and, if that was not enough, it included a USB 2.0 interface to boot. It had also been used in previous Silicon Chip projects so it was not a total stranger.

The clincher was when we checked the Microchip price list. The PIC18F4550 with all its fancy features was 20% cheaper than the plain old PIC16F877A!

As an American would say... the decision was a "no brainer".

Resistor Colour Codes

	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	100kΩ	brown black yellow brown	brown black black orange brown
❑	2*	82kΩ	grey red orange brown	grey red black red brown
❑	2*	47kΩ	yellow violet orange brown	yellow violet black red brown
❑	1	22kΩ	red red orange brown	red red black red brown
❑	1	10kΩ	brown black orange brown	brown black black red brown
❑	1*	8.2kΩ	grey red brown	grey red black brown brown
❑	1	6.8kΩ	blue grey red brown	blue grey black brown brown
❑	2	3.3kΩ	orange orange red brown	orange orange black brown brown
❑	1	10Ω	brown blackblack brown	brown black black gold brown

* - Optional, see text

1 2 3 4 5 6...

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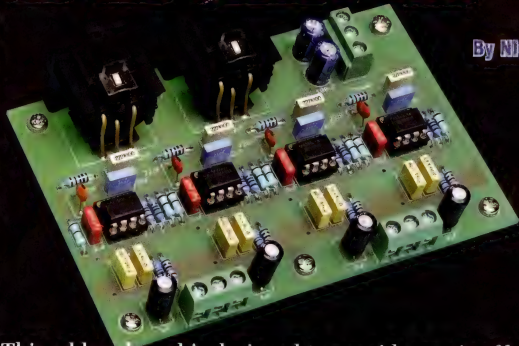
A balanced output board for the Stereo DAC

By NICHOLAS VINEN



This add-on board is designed to provide a pair of balanced audio outputs for the High-Quality Stereo DAC (Sept-Nov 2009). Two 3-pin male XLR connectors are used for the new outputs and they can either replace or augment the existing unbalanced outputs without affecting their performance.

BALANCED AUDIO is used in recording studios and on stage because of its improved noise immunity. This is due to the fact that the signal is sent differentially (ie, as two signals 180° out of phase) and then converted to a single-ended voltage signal at the far end.

If any noise is picked up in the cable, it affects the two out-of-phase signals equally so that when the signals are subsequently subtracted, most of the noise is eliminated.

In addition, the DAC's performance at the balanced outputs generally exceeds that of the unbalanced outputs, although only by a small margin. The signal-to-noise ratio, frequency response and channel separation are all better, although we measured a tiny bit more distortion from the balanced outputs. However, both levels are so low as to be almost negligible.

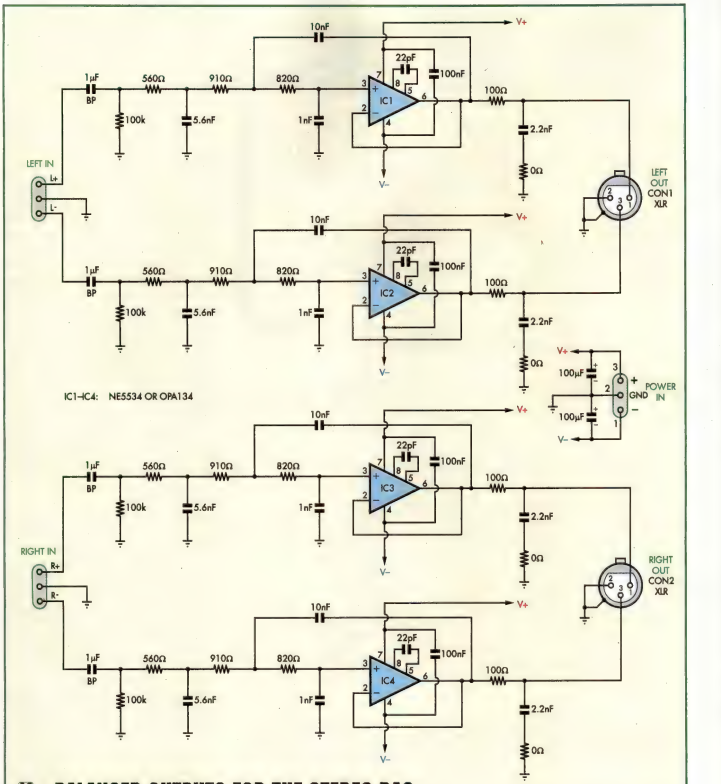
Table 1: Balanced/Unbalanced Output Performance Comparison

Measurement	Unbalanced	Balanced
THD+N, 1kHz	0.00090%	0.00095%
SNR (unweighted)	-108dB	-112dB
SNR (A-weighted)	-114dB	-116dB
Frequency Response, 20Hz-20kHz	+0,-0.15dB	+0.02,-0.05dB
Channel Separation @ 1kHz	-105dB	-115dB
Channel Separation @ 20kHz	-73dB	-111dB

Performance

At this point, it is worth mentioning that during the development of this board, we used a new source of digital sinewave data for distortion measurements. This revealed that the DAC is capable of lower distortion than originally quoted. With a 44.1kHz 16-bit computer-generated sinewave, the THD+N at 1kHz is 0.0012% and with a 48kHz 20-bit sinewave the THD+N is 0.0009%.

These measurements are only slightly higher than the distortion



BALANCED OUTPUTS FOR THE STEREO DAC

Fig.1: the incoming differential signals from the the DAC Board are fed to separate passive high-pass filter stages and then to four active low-pass filter stages based on op amps IC1-IC4. These op amps then drive pins 1 & 3 of the XLR output sockets via passive low-pass filters based on 100Ω resistors and 2.2nF capacitors.

measured directly from the Audio Precision System One's internal sine-wave generator (0.0006%) so it's hard to say exactly what the actual level of distortion is. However, we can safely say it is very low indeed.

Table 1 shows a performance comparison between the balanced and unbalanced outputs, measured with the new 48kHz 20-bit sinewave source.

Note that while the channel separation from the balanced outputs is

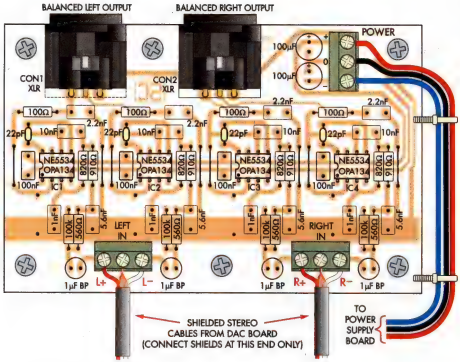


Fig.2: follow this parts layout diagram to assemble the Balanced Output Board. The L+, L-, R+ and R- inputs are derived from the DAC Board (see below).

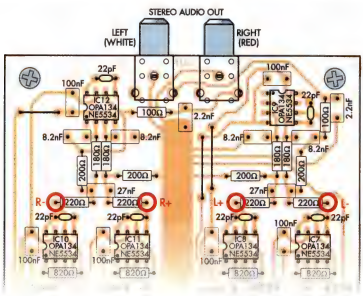


Fig.3: the L+, L-, R+ and R- points on the DAC Board are marked here in red and drive the inputs of the Balanced Output Board. Note that the parts on the righthandside of this board drive the left channel output socket and vice versa.

much better than from the unbalanced outputs, in practice 73dB is more than adequate. In fact, it's very unlikely that anybody can hear the difference under normal circumstances.

Deriving balanced outputs

In practice, providing balanced outputs from the DAC is relatively straightforward since the DAC chip we used – the DSD1796 – itself has balanced outputs. These are converted to single-ended signals on the DAC board via a pair of differential amplifiers (IC9 & IC12 on Fig.3, September 2009). This means that the simplest way to provide balanced outputs is to directly tap the signal going to these differential amplifiers.

Theoretically, the outputs from the current-to-voltage (I/V) converter stages (ICs7, 8, 10 & 11) could be connected directly to the XLR socket outputs via 100Ω isolating resistors. However, we have come up with a more complicated design for a couple of reasons.

First, making a direct connection from the existing DAC board to the XLR sockets would bypass some of the low-pass filtering. This filtering is important because it's designed to remove high-frequency switching artefacts.

Second, a direct connection would load the I/V converter stages even more than they already are. In view of this, asking the op amps to drive an additional, unknown amount of cable capacitance seems unwise.

As a result, we feed the signal at the outputs of the I/V converter stages to an interface board to provide the balanced outputs. This board also includes four active low-pass filter stages based on NE5534 op amps.

Note that because the DAC's outputs are asymmetric (they only sink current), the outputs of the I/V converters (ICs 7, 8, 10 & 11) are always above 0V. As a result, these outputs are AC-coupled to the op amps in the balanced output stages to remove the DC component of the signal, so that it is centred around 0V.

Circuit details

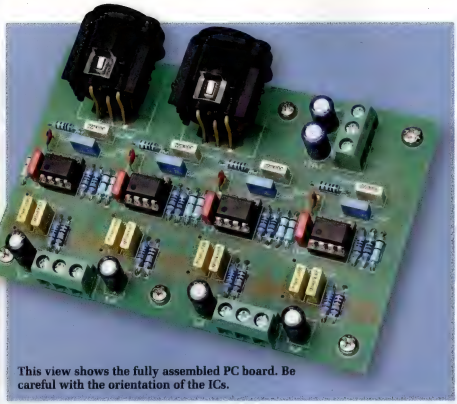
Refer now to Fig.1 for the circuit details. It consists of two identical sections, one for each channel.

As mentioned, the incoming differential signals are AC-coupled via 1µF bipolar capacitors. These capacitors and the following RC components also form 6dB/octave high-pass filters. We have set the corner frequency of this filter low enough (1.6Hz) so that it has minimal effect on the 20Hz-20kHz frequency response (-0.046dB).

The remainder of the circuit consists mainly of the four active low-pass filter (LPF) stages and these are based on op amps IC1-IC4. Each filter is an active third-order LPF with a -3dB point (corner frequency) of 52kHz and a slope of -18dB per octave. These are then followed by passive first-order 720kHz low-pass filters, each based on a 100Ω current-limiting resistor and a 2.2nF capacitor.

These are identical to those used at the outputs of IC9 & IC12 on the DAC board and attenuate the 60MHz (approx.) switching spikes that the DAC generates.

In addition, since these are passive



This view shows the fully assembled PC board. Be careful with the orientation of the ICs.

filters, they are effective at filtering any high-frequency noise which the active filter stages may allow through.

The third order active LPFs only require a single op amp each (ICs1-4). However, unlike the DAC board, there is no performance advantage to be gained by using OPA134 op amps over NE5534s. Instead, testing has revealed that it is the I/V converter stages on the DAC board that benefit from the improved performance of the OPA134s.

By contrast, on the Balanced Output Board, the op amps only act as unity gain voltage buffers and the NE5534 performs admirably in this role. However, you can use OPA134s if you wish. For example, if you are not going to be installing the unbalanced outputs, you will have two spare OPA134s from the DAC board, so you only need to buy two more for the Balanced Output Board.

Note that the board has pads for the 22pF compensation capacitors required for the NE5534s and if you are purchasing op amps specifically for this board, NE5534s are recommended. Alternatively, if you decide to use OPA134s, you can leave out the 22pF capacitors (although installing them does not hurt).

The output of each op amp appears at pin 6. IC1 & IC2 provide the differential output signals for the left channel and these respectively drive pins 1 & 3 of the left-channel XLR socket via the low-pass passive filter stages. Similarly, IC3 & IC4 drive the right-channel XLR socket.

The XLR outputs are mounted directly on the PC board, while the input signals from the DAC board are fed in via 3-way screw terminal blocks. The latter provide a 0V connection for shielding purposes but the shield should only be connected at one end.

Power for the Balanced Output Board circuitry is derived directly from the ±15V outputs of the Power Supply Board. The supply rails are fed in via another 3-way screw terminal block on the Balanced Output Board, with two 100µF capacitors providing additional filtering.

Construction

Refer now to Fig.2 for the parts layout on the PC board. As can be seen, the assembly is straightforward.

Begin by checking the PC board for defects, then start the assembly by installing the resistors and wire links. You can either use 0.71mm tinned copper wire for the links or you can use 0Ω resistors (as in the prototype).

Next, install the IC sockets, ensuring they are correctly oriented. Follow these with the terminal blocks, ensuring that the openings point towards the edge of the board in all cases. Be sure to seat them properly on the PC board before soldering their pins.

The capacitors can go in next. The two 100µF filter capacitors are polarised, so watch their orientation. Follow them with the XLR connectors, then install the four ICs (again, make sure they are correctly oriented).

Finally, complete the board assembly by fitting M3 x 6mm tapped Nylon spacers to the mounting points. You will need at least four of these (one in each corner) and they should be secured using M3 x 4mm screws.

It's also a good idea to fit an extra spacer between the two XLR sockets, to ensure extra rigidity when plugging in external leads. An extra mounting

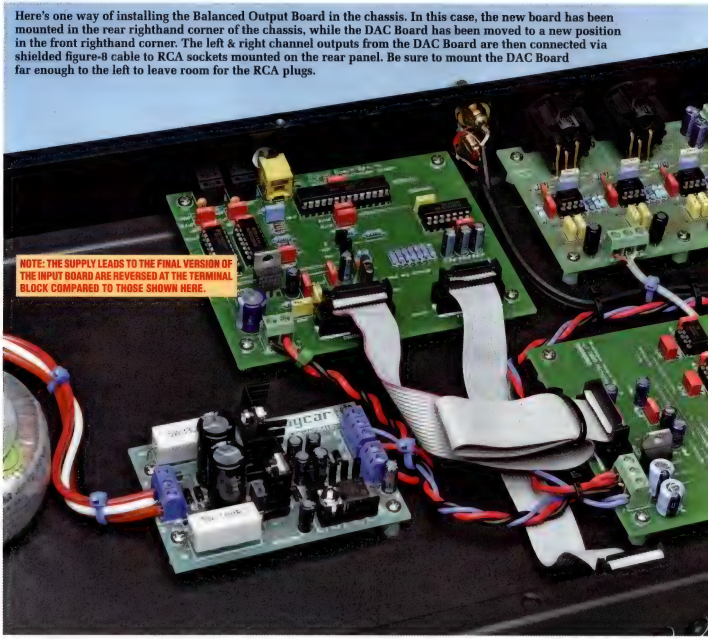
Table 3: Capacitor Codes

Value	µF Value	IEC Code	EIA Code
100nF	0.1µF	100n	104
10nF	0.01µF	10n	103
5.6nF	.0056µF	5n6	562
2.2nF	.0022µF	2n2	222
1nF	.001µF	1n0	102
22pF	N/A	22p	221

Table 2: Resistor Colour Codes

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	4	100kΩ	brown black yellow brown	brown black black orange brown
❑	4	910Ω	white brown brown brown	white brown black black brown
❑	4	820Ω	grey red brown brown	grey red black black brown
❑	4	560Ω	green blue brown brown	green blue black black brown
❑	4	100Ω	brown black brown brown	brown black black black brown

Here's one way of installing the Balanced Output Board in the chassis. In this case, the new board has been mounted in the rear righthand corner of the chassis, while the DAC Board has been moved to a new position in the front righthand corner. The left & right channel outputs from the DAC Board are then connected via shielded figure-8 cable to RCA sockets mounted on the rear panel. Be sure to mount the DAC Board far enough to the left to leave room for the RCA plugs.



point is also provided along the opposite edge of the board but its use is optional.

Installation

There are a couple of options when it comes to installing the Balanced Output Board into a case.

First, if you are starting from scratch and drilling your own case, then the board can be mounted with its XLR connectors protruding through the front panel, on the righthand side. This would mean moving the Switch Board further towards the centre of the front panel than in the prototype, to allow room for the Balanced Output Board.

Alternatively, if you are installing the new board into an Altronics kit chassis, it will have to be mounted in the rear righthand corner of the chassis, in place of the DAC board – see photo. The DAC board is moved to the location shown in the photo and installed with its RCA output connectors facing towards the righthand side panel. The RCA outputs are then connected via figure-8 shielded cable to a pair of RCA sockets mounted on the rear panel between the Input Board and the Balanced Output Board.

Which ever method you choose, you will have to drill the necessary mounting holes for the boards and cut holes in the front or rear panel to match the XLR sockets.

The XLR socket holes are the first on the list. These are holes best made by initially drilling two pilot holes 35.5mm apart at the correct height. They are then reamed out to 22mm to allow the socket centre sections to protrude through.

That done, mark out and drill the four 2.5mm holes around the outside edge of each cutout. The XLR connectors can then be firmly secured to the panel using the supplied self-tapping screws.

Having secured the assembly in this manner, the next step is to remove the Nylon spacers so that you can mark out the mounting holes for the Balanced Output Board in the base of the chassis. The PC board is then removed so that the holes can be drilled (to 3mm).

Once these holes have been drilled,

mark out and drill the two holes for the panel-mount RCA sockets. Again, use a pilot drill to start the holes, then carefully ream them to size (9.5mm) using a tapered reamer.

If you are modifying an Altronics kit, then the DAC Board can be installed in the location shown in the photo. Once again, you will have to mark out and drill a new set of mounting holes. Note that the edge of the board should be at least 55mm from the righthand chassis panel, to ensure sufficient clearance for the RCA plugs.

Next, deburr all the mounting holes using an oversize drill before installing the boards in the chassis. Don't forget to refit the four screws through the panel to hold the XLR connectors in place. This step is vital because they are subject to quite a bit of force during cable insertion and removal.

Wiring

It's now just a matter of completing the wiring as shown in Figs.2 & 3 and the photo.

First, you will need to run three power supply leads (+15V 0V -15V) to the Balanced Output Board. These supply rails are derived from the output terminal block on the Power Supply Board.

Unfortunately, it can be difficult to fit two wires into the terminal block entries (due to the leads already running to the DAC board) but there is a way around this – splice the wires into a "Y" shape with heatshrink insulation applied to the join. You can then connect one end to the power supply, the middle to the DAC board and the remaining end to the Balanced Output Board. Make sure you don't get any of these +15V 0V -15V connections mixed up.

It's a good idea to twist the supply leads together as shown in the photo. This not only minimises noise pickup but also ensures that a lead cannot wander if it comes adrift. You should also use cable ties to additionally secure the supply leads at the terminal blocks.

The connections between the DAC Board and the rear-panel RCA sockets are run using figure-8 shielded cable (ie, two cores with separate shields – do not use 2-core cable with a common shield for these connections). As shown, the leads are directly soldered to the rear-panel RCA sockets at one end and are terminated in RCA plugs at the DAC Board end.

Alternatively, if you don't intend ever using the unbalanced outputs, then this wiring can be left out.

Two lengths of twin-core shielded cable are used for the signal connections between the DAC Board and the Balanced Output Board. Begin by stripping back 20mm of the outer insulation from one end of each cable and about 40mm from each of the other ends. Then, at the 40mm ends, trim the shield wires back completely so that they do not project out of the outer insulation.

Now, at the 20mm end of each cable, twist the shield wires together tightly and tin them with solder. That done, remove 10mm of insulation from the inner wires at both ends, then double the exposed wires back and tin them.

Finally, trim the shield wires back to about 10mm and attach the signal cables to the input terminal blocks on the Balanced Output Board - see Fig.2. As shown, the shield wire goes to the centre terminal of each block, the red wire to the "+" terminal and the white wire to the "-" terminal.

The red & white wires at the other end of each cable are connected to the pin 6 outputs of ICs 7, 8, 10 & 11

Parts List

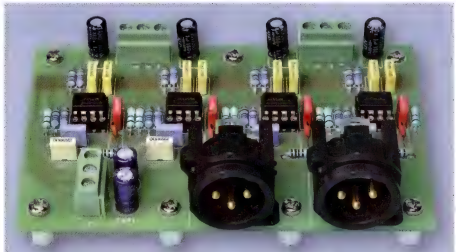
1 PC board, code 01101101, 110 x 67mm
2 PC-mount male 3-pin XLR connectors plus self-tapping screws (Altronics P-0874)
3 3-way screw terminal block (5.08mm pitch)
4 8-pin machined IC socket
6 10mm tapped Nylon spacers
6 M3 x 6mm machine screws
1 500mm length twin-core shielded cable

Semiconductors
4 NE5534 op amps (IC1-IC4)

Capacitors
2 100µF 25V electrolytic
4 1µF bipolar electrolytic
4 100nF MKT
4 10nF MKT
4 5.6nF MKT
4 2.2nF MKT
4 1nF MKT
4 22pF ceramic

Resistors
4 100kΩ
4 560Ω
4 910Ω
4 100Ω
4 820Ω

Miscellaneous
The following parts are necessary to complete the chassis wiring:
2 RCA plugs, 1 red, 1 black
2 panel-mount RCA sockets
1 500mm length figure-8 shielded cable
8 cable ties
1 600mm-length heavy-duty red hook-up wire
1 600mm-length heavy-duty blue hook-up wire
1 600mm-length heavy-duty black hook-up wire



Another view of the completed Balanced Output Board, this time looking at the XLR connectors. The latter are secured to the rear panel using the self-tapping screws supplied. This ensures that the solder joints on the board don't crack due to stress as cables are plugged in and removed.

on the DAC Board. The best place to make these connections is at the 220Ω resistors that connect to these pins, as shown in Fig.3.

You can either make the connections to the top of the DAC Board or you can solder the wires to the pads on the underside of the board (as in the prototype). If you are attaching the wires to the top of the board, simply melt a little solder onto the exposed resistor legs, then solder each wire in turn.

Alternatively, if you are not installing the unbalanced outputs, you can leave out the 220Ω resistors and simply feed the wires down through the board holes before soldering them to the pads. **Either way, you must protect the board so that the trimmed shield wires can't short against anything.** That can be done either by using heat-shrink sleeving or a blob of hot melt glue, or even insulating tape.

Once all the wiring has been completed, secure it in place using cable ties as shown in the chassis photo. This not only helps prevent leads from flexing and coming adrift but also ensures that a wire cannot move and contact other parts of the circuit (including the mains terminals on the back of the IEC socket) if its connection is broken.

Don't get the channels mixed

Be sure to connect the leads exactly as shown in Figs.2 & 3, so as not to transpose the left and right channels.

In particular, note that the components on the righthand side of the DAC Board are actually for the left channel, ie, they drive the left audio output socket. Similarly, the parts on the lefthand side of the board drive the right channel audio output socket. This was done to simplify the layout of the PC tracks running from the DAC chip (IC6).

All you have to do is run the signal leads as shown in Figs.2 & 3 and all will be correct. **There's just one wrinkle here – if you mount the Balanced Output Board on the front panel, then you should swap the signal leads running to the 3-terminal input blocks.** That way, the lefthand XLR socket (when looking at the front panel) will really be the left channel, while the righthand socket will be the right channel.

Testing

Once the power supply and signal wiring are complete, power the Stereo DAC up and check that the +15V and -15V inputs to the Balanced Output Board are correct. If these are OK, uou are then ready to connect the balanced outputs to your external equipment and check that they are functioning correctly.

If there is a problem, switch off immediately and use a multimeter to confirm that all power and signal connections are correct. If that checks out but it still doesn't work properly, you will need to remove the Balanced Output Board and check it for short circuits, missed solder joints and incorrect parts placement.

If you have not tested the rest of the DAC yet, then it's a good idea to temporarily disconnect the Balanced Output Board while you make the necessary checks. That way, you'll at least know that the rest of the DAC works correctly before looking for problems on the Balanced Output Board.

That's it – once wired up, the balanced outputs should provide a very clean output signal from the DAC, even with long cable runs. SC

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- 310mm long
- Recommended for ages 10+
- Spare parts are available

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Refer: Silicon Chip Magazine December 2009

This kit intercepts and alters the signal from engine sensors that supply a voltage signal to the engine control unit (ECU). Restore correct air/fuel ratios after engine modifications, prevent engine boost cuts; or alter sensor signals for improved drivability. Requires a hand controller for programming, RS232 cable and a suitable input signal. Kit includes PCB, case and electronic components.

Recommended with this kit:

Hand Controller	Cat. KC-5396	$67.95
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- DVD/VCD/MP3/WMA/JPEG playback
- DVD/R/CD/RW/CDR/RW playback
- ESP and flashback mechanism
- 4 channel x 20W RMS power output
- 2 x vid output
- Rear camera input
- ISO connector

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- Voltage range: 15-24V
- Current range: 2.04-6A
- Dimensions: 154(L) x 58(W) x 37(H)mm

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ifications:
enna: 11(H)mm - SMA plug
Indicator : SYS (Power) , Pairing
ensions: 72(L) x 30(W) x 14(H)mm
s 1 (up to 100M range)

$169

Cat: XC-4130

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B to RS-485/422 nverter

an RS-485/422 device to the 4 socket terminal give your hardware USB connectivity, it features rotection to guard against unpredictable voltage uitable for industrial, military, marine, science and built applications. One USB A male to male cable ed.

sions: 55(L) x 42(W) x 24(H)mm
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al to Ethernet Converter

nverter, computers can connect to serial devices over Ethernet. It's ideal people who need to monitor or access RS-232 based remotely or to share them over a network. There is nale RS-232 plug, an RJ-45 socket and a k to wire up RS-485 or RS-422 connections. can be accessed remotely through a simple web

ns:
10/100M
-232 , RS-485 and RS-422 -
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Cat: HB-5450

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NEW

19" Rack Blank Panels

Blank panels for fitting in unused space or configuring panels to your own requirements. Black powder coated steel, 1 or 2 unit, vented or plain. The vented panels are also useful at the back of rack enclosures for attaching wiring looms to.

1U Rack Mount Blank Panel Cat. HB-5420 $10.50
2U Rack Mount Blank Panel Cat. HB-5422 $12.95
1U Rack Mount Blank Panel - Vented Cat. HB-5424 $18.95
2U Rack Mount Blank Panel - Vented Cat. HB-5426 $27.95

NEW

Keyring Micro SD USB Card Reader

Microscopic would be the best way to describe this card reader at only 19 x 15mm, and that includes the USB plug. Ideal for the travelling shutterbug.

- USB 2.0 Micro SD compliant
- Keyring lanyard included

$9.95

Cat: XC-4759

NEW

Better, More Technical

All savings are based on original recommended retail prices.

Car Audio & Accessories

9" In-Car LCD Colour Monitor

Crisp high resolution, connect this 9" widescreen LCD to your source devices to entertain passengers with DVD movies or keep the kids amused with Xbox® or Playstation® gameplay. Featuring multisource inputs and reverse image function, it also doubles as a reversing camera monitor. The tilting bracket gives you several in-car options, including dash, ceiling and headrest mounting.

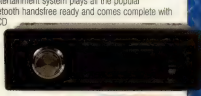
NEW

$199
Cat: QM-3781

- NTSC/PAL system
- 9" widescreen - 4:3 & 16:9 switchable format
- 800 x 480 display resolution
- 12VDC power input, 12W power consumption
- Includes mounting bracket and remote control

In-Dash Multimedia Player with USB and Bluetooth

A solid all-round performer, this in-car entertainment system plays all the popular multimedia formats and devices. It is Bluetooth handsfree ready and comes complete with detachable anti-theft panel with colour LCD display and slimline remote control.



- Front USB port, SD/MMC card slot and aux-in
- PLL tuner with 18 x FM and 12 x AM presets
- DVD±R/RW, CD-R/RW playback
- Supports MP3, JPEG and WMA files
- 4 channels x 20WRMS output (40WRMS max)
- 4-band equaliser (classic, pop, rock, flat)

NEW

$249
Cat: QM-3788

GPS Sunshades to Reduce Screen Glare

Simply clip to the top of your GPS unit.
Different types to fit popular in-car GPS models:
Garmin Nuvi, TomTom Go, Magellan Maestro, Navman etc.

NEW

Universal Sunshade 3.5" Cat. HS-9005 $14.95
Sunshade for TomTom 4.3" Cat. HS-9006 $19.95
Sunshade for Garmin 4.3" Cat. HS-9007 $19.95

Touchscreen Car Multimedia Player

Comprehensive in-car connectivity - this impressive unit plays all the popular AV formats from just about any portable media or mass storage device. Plus it's Bluetooth-ready for handsfree communication when paired with a Bluetooth enabled mobile phone. It's user-friendly touchscreen menu enables you to easily select and control several input play options. Mounting hardware, Bluetooth bus and remote control included.

NEW

- Motorised 7" touchscreen LCD (480 x 234 pixels)
- 22WRMS x 4 channels (45W max each)
- Front panel USB, SD & aux-in
- 1 x rear camera input, 1 x video output

$499
Cat: QM-3789

HID Dual Lamp Conversion Kits - 35 Watt

Used in the latest model luxury and high performance cars. High Intensity Discharge (HID) vehicle headlights are far brighter, whiter and more efficient than their quartz halogen predecessors.

NEW

- 35W HID Xenon lamps - H4 base
- 6000K colour temperature comparable to sunlight
- Extra bright 3200 lumens

Available in two easy-installation models:

HID Dual Lamp H4 Conversion Kit - low beam Cat. SL-3416 $99
HID Dual Lamp H4 Conversion Kit - high/low beam Cat. SL-3417 $149

Warning: State roads & traffic authorities prohibit the retrofitting of these products to cars with normal headlights. Advised to be used only for off-road and showroom vehicles when replacing quartz halogen bulbs, or as headlight replacements for HID factory-fitted new model vehicles.
Due mid January

Car Amplifier Wiring Kits

Complete wiring kits for installing a car amplifier - everything you need down to the cable ties and screws. Save $$ on the individual parts. 4G and 8G kits available, see our website for kit contents:

NEW

8G Wiring Kit Cat. AA-0442 $59.95
4G Wiring Kit Cat. AA-0444 $99.00

Twisted Pair RCA Stereo Audio Cables

Featuring RFI and EMI noise reduction to keep your car's audio sounding wholesome. This twisted pair RCA cable is made from double aluminium foil and quality copper braid shielding for that accurate sound transfer.

NEW

- Plug to Plug
- Split centre pin connectors
- Frosted jacket design
- Platinum-plated ends

5 Lengths:

0.3m	Cat. WA-1079	$14.95
0.5m	Cat. WA-1071	$14.95
1.5m	Cat. WA-1073	$19.95
2.5m	Cat. WA-1075	$24.95
5.0m	Cat. WA-1077	$29.95

Due mid January

HID Single Beam Bulbs

Drop-in replacements for cars that have separate HID bulbs for high and low beam. With 3000 hour lifespan, these can be used in single bulb housings but high beams will not function.

NEW

- 35W 70-100V
- 3,000 - 30,000K colour temperature
- 2500-3500 lumens

H3, H4 and H7 types available:

12V H3 HID Bulb Single Beam Cat. SL-3411 $24.95
12V H4 HID Bulb Single Beam Cat. SL-3412 $24.95
12V H7 HID Bulb Single Beam Cat. SL-3413 $24.95

Due mid January

Vifa Coaxial Car Speakers

Vifa coaxials will add true high fidelity to your car audio. All feature the legendary Vifa silk dome tweeters, strontium magnets and composite diaphragms. Available in 2 or 4-way configuration. Sold as a pair.

Vifa 5" 2 Way Car Speakers Cat. CS-2393

- Power handling: 60WRMS
- Nominal impedance: 4 ohms
- Frequency response: 50Hz - 20kHz
- Sensitivity: 87.9 dB SPL @1W, 1m

$119 pr
Cat: CS-2393

Vifa 6.5" 2 Way Car Speakers Cat. CS-2395

- Power handling: 80WRMS
- Nominal impedance: 4 ohms
- Frequency response: 45Hz - 20kHz
- Sensitivity: 86.3dB SPL @1W, 1m

$169 pr
Cat: CS-2395

Vifa 6 x 9" 4 Way Car Speakers Cat. CS-2397

- Power handling: 150WRMS
- Nominal impedance: 4 ohms
- Frequency response: 35Hz - 20kHz
- Sensitivity: 90 dB SPL @1W, 1m

$229 pr
Cat: CS-2397

Sound Dampening Pads

These pads are installed inside the door skins opposite the back of the speaker drivers. They absorb standing waves and resonances so you get maximum performance. Each pack includes cyanoacrylate glue for installation.

NEW

Sound Dampening Pad 7" - Pair $39.95
Suitable for 5 - 7" drivers
Cat. AX-3665

Sound Dampening Pad 12" - Single $39.95
Suitable for subs 10 - 15"
Cat. AX-3666

Massive Savings on Clearance Lines 10% to 70% OFF

Listed below are a number of discontinued (but still good) items that we can no longer afford to hold in stock. We need more space in our stores! You can get most of these items from your local store but we cannot guarantee this. Please ring your local store to check stock. At these prices we won't be able to ship from store to store.

Items will sell fast and stock is LIMITED - ACT now to avoid disappointment **Sorry - NO Rainchecks**

Stereo Valve Hybrid Amplifier 2 x 18WRMS

The circuitry is hybrid valve/solid state. This gives it better power output with lower hum and distortion. If you like the sound of valves but can't bring yourself to part with two grand for an amp, this could be for you. Two sets of stereo inputs plus separate bass and treble controls.

- Valves: 2 x 6N1, 2 x 6P15
- Power output: 18WRMS per channel
- Input sensitivity: 300mV
- Dimensions: 270(W) x 290(D) x 140(mm

Was $299

Limited Stock

$99

Cat: AA-0474

25mm Dome Tweeter

A compact dome tweeter for bookshelf or satellite speaker applications magnetically shielded, ferrofluid cooled.

- Nominal impedance: 5 ohms
- Power handling: 15WRMS
- Sensitivity: 92dB 2.83V at 1m
- Crossover frequency: 2500Hz

Was $39.95

Limited Stock

$9.95 Cat: CT-2009

Digital TV Set Top Boxes

Standard Definition

If you have an older TV that does not have a digital tuner, you will need a Digital TV set top box that will receive and decode the signals so they can be displayed. With these set top boxes you can enjoy more channels, extra features and clearer reception on your old analogue TV at an excellent price.

Two standard definition DTV set top box models available:

Economy SD DTV Set Top Box

With composite Video and audio left and right outputs.

- Size: 120(W) x 35(H) x 100(D)mm

Was $49.95

Not available in New Zealand

$29.95 Cat: XC-4914

SD DTV Set Top Box with Recording Output

Features a USB port for AV recording as well as playback. With composite AV and S-video plus digital audio and analogue left and right audio outputs.

- Size: 189(W) x 40(H) x 117(D)mm

Was $64.95

Not available in New Zealand

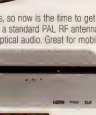
$49.95 Cat: XC-4912

High Definition

Digital and HD ready. Digital and high definition TV is already with us, so now is the time to get with the program. Receives all Australian digital TV broadcasts from a standard PAL RF antenna input. Outputs are HDMI, component video, composite video, and optical audio. Great for mobile use such as caravans, camping, 4WD's etc.

- Remote requires 2 x AAA batteries.
- On-screen menus
- Selectable aspect ratio 4:3/16:9
- DVB-T & MPEG-2 HD & SD compliant
- Supports up to 1080p resolution
- 12VDC Plugpack included
- Dimensions: 220(W) x 140(D) x 42(H)mm

Not available in New Zealand



$119 Cat: XC-4916

Gifts & Gadgets Clearance

Description	Cat No.	WAS	NOW	SAVE
Colour Changing Cube with Timer & PSU	GH-1814	$49.95	$19.95	$30.00
Desktop Drum Kit with Record Option	GC-4080	$29.95	$19.95	$10.00
Fan with LED Message - Battery operated	GH-1069	$14.95	$7.50	$7.45
Fan with Mini LED Light Show - Battery operated	GH-1075	$8.95	$3.95	$3.00
Fan with Water Jet Spray - Small	GH-1070	$6.95	$3.95	$3.00
Novelty Sweat Box	GH-1316	$19.95	$9.95	$10.00
Pre-retail Listening Device	GH-1910	$49.95	$24.95	$25.00
Remote Control Giggle Machine with 6 Sounds	GH-1085	$14.95	$9.95	$5.00
Shot Glass with Flashing LED	GH-1150	$3.95	$0.65	$3.30
USB Missile Launcher with Webcam	GC-4084	$109.00	$49.95	$59.05

Audio Video Accessories Clearance

Description	Cat No.	WAS	NOW	SAVE
AV HDMI Cable Tester with Carry Bag	AA-0406	$149.00	$99.00	$50.00
AV HDMI Repeater/Extender Ver 1.3	AC-1697	$54.95	$29.95	$25.00
AV HDMI Repeater/Extender with PSU	AC-1696	$94.95	$49.95	$45.00
AV HDMI/RGB/DVD Computer Switch	AC-1687	$349.00	$199.00	$150.00
AV Sender Spare Receiver to suit (AR-1838)	AR-1839	$54.95	$37.95	$17.00
AV Sender Spare Receiver to suit (AR-1844)	AR-1845	$59.95	$39.95	$20.00
AV Sender Wireless 2.4GHz Dual Input with IR Remote	AR-1838	$129.95	$99.95	$30.00
AV Sender Wireless 2.4GHz TX/RX Requires 4AA	AR-1852	$79.95	$44.95	$35.00
Cable Coax 75R RG6 Belden - Sold per metre	WB-2008	$1.75	$0.35	$1.40
Cable Speaker Twisted 2 Core OFC - Sold per metre	WB-1723	$5.95	$1.30	$4.65
Cable Speaker Twisted 2 Core Red/Blue - Sold per metre	WB-1750	$1.35	$0.55	$0.80
Cable Speaker Twisted 2 Core Red/White - Sold per metre	WB-1751	$1.35	$0.55	$0.80
Cable Speaker Twisted 4 Core - Sold per metre	WB-1760	$2.30	$1.00	$1.10
Car MP3/Cassette Adaptor with SD Card Slot	AR-1764	$69.95	$39.95	$30.00
Computer Headphones with Microphone	AA-2028	$17.95	$6.95	$11.00
DJ Dual MP3 Player Controller - Rack mountable	AC-0492	$499.00	$349.00	$150.00
Dock: 2:1 Speaker - Black for iPod®	CS-2467	$199.00	$118.00	$81.00
FM Stereo Transmitter for iPod®	AR-3112	$39.95	$12.95	$27.00
Nano Earphones & Lanyard for iPod® Nano	AA-2029	$19.95	$8.95	$11.00
Rechargeable Transmitter for iPod®	AR-1859	$69.95	$34.95	$35.00
Lead AV Game PS3 = 3 RCA Leads 1.8m	WW-7430	$29.95	$9.95	$20.00
Lead AV RCA 2 Plugs - 1 S-Video Plug Scart 1.5m	WQ-7246	$34.95	$9.95	$25.00
Lead AV RCA 2 Scart Plugs - 1 S-Video Plug Scart 1.5m	WQ-7247	$34.95	$9.95	$25.00
Lead AV Scart Plug - Socket Concord 1.5m	WQ-7249	$34.95	$9.95	$25.00
Lead Gamers Delight 3 Rs - S-Video & Audio 1.8m	WW-7436	$29.95	$9.95	$20.00
Lead VID RCA 6 Plugs - RGB Plug Scart 1.5m	WQ-7243	$49.95	$24.95	$25.00
Multimedia Cable Tester - Tests Voice, Data & Video Cables	QP-2290	$199.00	$99.00	$100.00
Noise Cancelling Earphones with Adaptors	AA-2057	$39.95	$22.50	$17.10
Noise Cancelling Headphones HiFi	AA-2058	$99.95	$59.95	$40.00
Remote Control Car Media Player	AR-1867	$109.00	$69.00	$40.00
Remote Control IR Extender	AR-1810	$49.95	$29.95	$20.00
Single DJ Headphone with Handle	AA-2059	$69.95	$34.95	$35.00
Speaker 10" Kevlar/Paper Cone Woofer	CW-2158	$179.00	$124.00	$55.00
Speaker 2:1 Surround Sound System with Amp	CS-2466	$199.00	$99.00	$100.00
Speaker 2.4GHWMD 2 way for Matrix use	CS-2282	$84.95	$34.95	$50.00
Speaker 4" High-End Woofer/Mid Range Driver	CW-2151	$47.95	$14.95	$33.00
Speaker 5" High-end Woofer/Mid Range Driver	CW-2152	$89.95	$49.95	$40.00
Speaker 500WMD 3 way Stereo Amp	AR-1807	$169.00	$109.00	$60.00
Speaker 6.5" Kevlar/Paper Cone Woofer	CW-2154	$99.95	$59.95	$40.00
Speaker 8" Kevlar/Paper Cone Woofer	CW-2156	$159.00	$99.00	$60.00
Speaker Black Stand 260mm (H) - Sold as a pair	CW-2943	$69.95	$45.95	$24.00
Speaker Piezo Horn HD-02	CT-1933	$6.95	$2.45	$4.50
Speaker Ribbon Tweeter - 200WRMS	CT-2032	$59.95	$34.95	$25.00
Speaker Tweeter Horn 400WRMS KSN1141A	CT-1912	$54.95	$24.95	$30.00
Stereo Bluetooth Adaptor	AR-1854	$69.95	$34.95	$35.00
Travel Case - 19" Rack Mount DJ Road Case	HB-6347	$149.00	$99.00	$50.00
Travel Case for LPs - Aluminium	HB-6345	$79.95	$34.95	$45.00
Wireless 2.4GHz Digital Headphone and Transmitter	AA-2035	$99.95	$69.95	$30.00
Wireless 2.4GHz Digital Stereo Headphones	AA-2072	$99.95	$59.95	$40.00
Wireless Remote Control for iPod®	AR-3119	$24.95	$12.95	$12.00

Car Audio & Accessories Clearance

Description	Cat No.	WAS	NOW	SAVE
1 Farad Capacitor with Coloured LED Display	RU-6762	$119.00	$83.00	$36.00
2 Farad Capacitor with Coloured LED Display	RU-6751	$169.00	$115.00	$54.00
Cable Auto 15A Figure 8 Red & Black - Sold per metre	WH-3078	$2.50	$1.00	$1.50
Cable Auto 25A Black - Sold per metre	WH-3083	$3.50	$0.80	$2.70
Cable Auto 25A Red - Sold per metre	WH-3081	$1.50	$0.80	$0.70
Cable Microphone 2 Core Screened Black - Sold per metre	WB-1532	$5.50	$2.00	$3.50
Car Alarm 2 Way Paging System + Rechargeable Remote	LA-4018	$329.00	$229.00	$100.00
Car DVD/CD Player with 7" LCD Monitor	GM-3787	$385.00	$259.00	$126.00
Car DVD/CD Player with Bluetooth	GM-3786	$269.00	$185.00	$84.00
Car Speaker 10" Venom Sub Woofer	CS-2356	$249.00	$159.00	$90.00
Car Speaker 12" Response Sub Woofer	CS-2354	$249.00	$149.00	$100.00
Car Speaker 12" Venom Sub Woofer	CS-2358	$119.00	$79.95	$39.05
Car Speaker 2" Reefer/Dome Tweeter 2 Way Coax	CS-2372	$159.00	$94.00	$54.95
Car Speaker 6" 60WRMS Kevlar Splits	CS-2327	$159.00	$75.00	$84.00
Car Speaker 6" Venom Splits with Silk Tweeter	CS-2389	$89.95	$59.95	$30.00
Car Speaker 6.5" 60WRMS Kevlar Splits	CS-2328	$169.00	$89.95	$79.05
Car Speaker 6.5" Component Car Splits + Ribbon Tweeter	CS-2338	$299.00	$179.00	$120.00
Car Speaker 6.5" Kevlar/Dome Tweeter 2 Way Coax	CS-2374	$119.00	$59.00	$60.00
Car Speaker 6x9 4 Way Venom Speaker with Silk Tweeter	CS-2385	$249.00	$149.00	$100.00
Car Speaker 6x9 Kevlar/Dome Tweeter 2 Way Coaxial	CS-2376	$179.00	$75.00	$104.00
LCD Monitor TFT-7" in Car TV with Remote	GM-3782	$269.00	$159.00	$110.00
LCD Monitor with 7" Bluetooth Rear Vision Mirror	GM-3763	$239.00	$139.00	$100.00
OBD II LCD Scan Tool	QP-2294	$199.00	$99.00	$100.00
Lead AV Car RCA 2 Plugs - 2 Plugs OFC 2.5m	WA-1072	$17.95	$4.95	$13.00
Power Window Closer 2 Door	LR-8651	$59.95	$39.95	$20.00
Power Window Closer 4 Door	LR-8653	$79.95	$44.95	$35.00
Tester Battery/ Charger/ Alternator 24VDC	QP-2259	$12.95	$4.95	$8.00
Wireless Relay Immobiliser Slave	LA-8676	$99.00	$67.95	$31.05
Car Ribbon Tweeter with Crossover & Mounts	CS-2339	$99.95	$62.95	$37.00
Car Lead RCA Car Audio - 2 Plugs 0.5m	WA-1068	$12.95	$2.95	$10.00

***Savings off original RRP - Limited Stock**

No rain checks, may not be available at all store locations - call your local Jaycar store to check stock

Better, More Technical

Jaycar Electronics

All savings are based on original recommended retail prices.

Massive Savings on Clearance Lines

10% to 70% OFF

HARDCORE ELECTRONICS CLEARANCE

Description	Cat No.	WAS	NOW	SAVE
23 Piece Bit Set with Driver & Ratchet Handle	TD-2029	$34.95	$19.95	$15.00
3 in 1 Knife/LED Torch/Bottle Opener Set	TH-1901	$14.95	$6.95	$8.00
7" Lineman Pliers	TH-2308	$14.95	$6.95	$8.00
8" Adjustable Wrench	TH-2312	$14.95	$6.95	$8.00
Adjustable Hole Saw 158 to 254mm	TD-2522	$79.95	$44.95	$35.00
Adjustable Hole Saw 63 to 177mm	TD-2520	$69.95	$36.95	$33.00
Assembly Tool Kit for Solar Power Connectors	TH-1930	$9.95	$5.95	$4.00
Assorted Bungee Cords - 25pcs	HP-0636	$19.95	$12.95	$7.00
Crimp Tool Compression	TH-1802	$79.95	$49.95	$30.00
Desoldering Braid Dispenser	NS-3040	$9.95	$6.95	$3.00
Desoldering Braid Dispenser Gun	NS-3042	$79.95	$49.95	$30.00
Screwdriver Cordless Ergonomic 4.8V with Bits & Charger	TD-2492	$29.95	$14.95	$15.00
Epoxy Repair Kit	NA-1520	$5.95	$2.95	$3.00
Fuse Blade Mini 3A Pink with Lamp Indicator	SF-5050	$1.25	$0.35	$0.90
Glue 25ml Metal Epoxy	NA-1516	$5.95	$2.45	$3.50
Glue Fix-Lock Anerobic	NA-1502	$7.95	$3.95	$4.00
Handyman Laser Level	ST-3113	$39.95	$9.95	$30.00
Magnetic Wrist Tray	TH-1971	$14.95	$5.95	$9.00
Magnifier Lab Desktop Lamp	GM-3529	$49.95	$29.95	$20.00
Plug Line XLR/5P Silver/Black - Amphenol	PP-1070	$14.95	$4.95	$10.00
Plug Panel XLR/4P Silver - Amphenol	PP-1044	$11.95	$4.25	$7.70
Plug Panel XLR/5P Black - NEXUS	PP-1073	$7.95	$2.95	$5.00
Plug Panel XLR/5P Silver - Amphenol	PP-1072	$17.95	$6.55	$11.40
Proton Exchange Membrane (PEM) Fuel Cell - 600mW	ZM-9082	$149.95	$49.95	$100.00
Proton Exchange Membrane (PEM) Fuel Cell- 300mW	ZM-9080	$99.00	$40.00	$59.00
Screwdriver 6 in 1 set	TD-2028	$18.95	$11.95	$7.00
Screwdriver Cordless 3.6V with Charger	TD-2445	$13.95	$7.95	$6.00
Screwdriver Remover - Pack of 5	TD-2079	$11.95	$5.95	$6.00
Screwdriver with LEDS set - 10 Bits	TD-2091	$22.95	$14.95	$8.00
Socket Line XLR/5P Silver/Black - Amphenol	PS-1074	$18.95	$6.95	$12.00
Socket Panel XLR/4P Lock Silver - Amphenol	PS-1046	$16.95	$5.95	$10.00
Socket Panel XLR/5P Lock Black - NEXUS	PS-1079	$9.50	$1.50	$8.00
Socket Panel XLR/5P Lock Silver - Amphenol	PS-1076	$24.95	$7.95	$17.00
Spare Tip SMD 2mm to suit TS-1700 (2 pieces)	TS-1701	$19.95	$4.95	$15.00
Watercard PIC16F628+24LC64 = Emerald	ZZ-9820	$14.95	$9.95	$5.00
Wall Plate with 2 x HDMI Skts - White	PS-0286	$29.95	$19.95	$10.00
Wall Plate with HDMI Skt - White	PS-0285	$19.95	$11.95	$8.00

IT & COMMS CLEARANCE

Description	Cat No.	WAS	NOW	SAVE
5.1 Active PC Speakers 240V	XC-5187	$79.95	$44.95	$35.00
Active Desktop Speaker for iPod®	TC-5188	$59.95	$34.95	$25.00
Adaptor Firewire 6P Plug - 4P Socket IEEE1394	PA-0912	$8.95	$1.25	$7.70
Adaptor Nut Modem 025 Plug - Socket	PA-0883	$8.95	$1.45	$7.50
Adaptor Plug Serial - Plug PS2	PA-0944	$8.95	$0.95	$8.00
Adaptor Socket D9 Serial - Socket PS2	PA-0947	$8.95	$0.75	$8.20
Antenna 2.4GHz Flat Panel 10dB gain	AR-3275	$89.95	$33.95	$56.00
Antenna 2.4GHz Indoor Ceiling Mount 3dB Gain	AR-3271	$49.95	$24.95	$25.00
Antenna 2.4GHz Wireless Networking 5dB Gain	AR-3270	$19.95	$9.95	$10.00
Antenna 3.5GHz Flat Panel 12dB with Bracket	AR-3274	$119.95	$49.95	$70.00
Cable CAT5e Solid blue - Sold per metre	WB-2028	$1.15	$0.25	$0.90
Cable CAT6 Solid Grey - Sold per metre	WB-2028	$1.95	$0.45	$1.50
CD/DVD Labeling Kit	XC-4920	$14.95	$3.95	$11.00
Digital Microscope Mobile 90x Zoom	QC-3245	$149.00	$79.00	$70.00
Digital Microscope Mobile w/ Image Capture 90x Zoom	QC-3246	$249.00	$169.00	$80.00
Digital Pen Notetaker	XC-0355	$179.00	$99.00	$80.00
Docking Station for PSP®	XC-5190	$79.95	$44.95	$35.00
External Hard Drive Case 2.5" with Finger Print Security	XC-4868	$99.00	$49.00	$50.00
Gaming Headphones with Bass Shaker & Mic	XC-4969	$49.95	$29.95	$20.00
GPS Bluetooth Receiver	XC-4895	$149.00	$79.00	$70.00
Hub Motorised 3 Port Retractable	XC-4877	$29.95	$14.95	$15.00
MP3/3-4 Player AV/SVGA out, RC & PSU - No HDD	XC-4866	$169.00	$99.00	$70.00
Internet Digital TV Tuner IPTV	XC-4851	$169.00	$115.00	$54.00
Active Speaker for iPod® Shuffle	XC-5189	$19.95	$9.95	$10.00
Laptop Fingerprint ID PCMCIA	XC-4843	$129.00	$69.00	$60.00
Lead ATA133 IDE Internal - 900mm Black	PL-0974	$35.00	$19.00	$15.00
Lead PS2 Y-Adaptor Plug to 2 Socket	PL-0877	$12.95	$4.95	$8.00
Mobile Active Speakers for iPod®	XC-5179	$79.95	$34.95	$45.00
Plug Line BNC Gold Suits 75R Digital Coax	PP-0654	$6.70	$2.50	$4.20
Portable Active Speakers for iPod® & MP3 Players	XC-5186	$39.95	$11.95	$28.00
PowerPoint® Presenter with Remote Control	XC-5405	$199.00	$119.00	$80.00
PSP High Capacity Clip-On Battery Pack	XC-5198	$119.95	$64.95	$55.00
RS232 Mini Tester DZ5 Socket to DZ5 Plug	PA-0866	$19.95	$5.95	$14.00
USB Data Storage Bridge	XC-4962	$99.95	$59.95	$40.00
USB Hub 4 Port In-Desk Grommett	XC-4863	$24.95	$14.95	$10.00
USB Optical Mouse & VoIP Phone	XM-5136	$59.95	$29.95	$30.00
USB Optical Mouse Gel Themed with Mouse Mat	XM-5129	$24.95	$7.75	$17.20
USB Optical Mouse Waterproof	XM-5139	$39.95	$19.95	$20.00
USB Powered MP3 Speakers	XC-5161	$99.95	$44.95	$45.00
Webcam USB VGA Black & Silver	QC-3221	$34.95	$19.95	$15.00

2 Input Digital Thermometer

This is an industrial quality, hand held two input thermometer. It features an easily read backlit display and measures temperatures from -50°C to +1,300°C.The unit is supplied with two temperature probes and holster.

- 76(W) x 170(L) x 50(H)mm

Was $99.95 Limited Stock

SAVE $50 **$49.95** Cat: QM-1600

Trade Quality Digital Multimeter

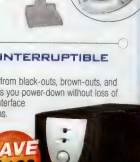
Ergonomically designed slim shape with one hand operating knob and buttons. It has overload protection, easy battery replacement, is compact, yet extremely rugged, this DMM would be an excellent investment for the apprentice to the professional tradesman. This meter is supplied with a protective holster and test lead.

- Display: 4000 count
- Category: Cat IV 600V
- 164(L) x 82(W) x 44(D)mm

Was $199 Limited Stock

SAVE $60 **$139** Cat: QM-1623

Bench Laboratory Magnifier Lamp



This laboratory magnifier lamp has a 115mm diameter lens that provides 3 x magnification and a stand that enables the magnifier lens to be positioned on almost any angle desired.

- 22 Watt circular fluoro light
- Maximum head reach 450mm
- Base measures 200(W) x 280(D) x 40mm(H)
- 240VAC operated

Was $149 Limited Stock

SAVE $90 **$59** Cat: QM-3522

Off-Line or Stand-by Uninterruptible Power Supplies

Protect your valuable computer system and critical data from black-outs, brown-outs, and power surges. Battery back time is 10 minutes which lets you power-down without loss of data! The UPS is supplied with back up batteries, USB interface cable, and software. See our website for full specifications.

Two models available:

650VA
Cat. MP-5200
Was $129
Limited Stock

SAVE $40 **$89** Cat: MP-5200

1000VA
Cat. MP-5202
Was $249
Limited Stock

SAVE $120 **$129** Cat: MP-5202

3 Port Motorised Retracting USB Hub

Just touch the top and your USB hub will rise from the surface of your desk to do your bidding. Touch it again and it lowers itself back into place and out of the way. It has 3 USB 2.0 ports and also acts as a cable grommet to keep all your computer cables neat and tidy.

- Powered by USB
- Mounting hole: 75mm
- Mounting depth: 70mm
- Diameter: 92mm

Was $29.95

SAVE $15 **$14.95** Cat: XC-4877

Get Ready for Australia Day!

Show your true nationalistic colours on your desk. Fly the flag and Australians all let us rejoice...ideal office desktop accessory!

- Dimensions: 220(H) x 60(Dia)mm

Was $14.95
Not available in New Zealand

SAVE $8 **$6.95** Cat: GH-1945

Savings off original RRP • Limited Stock
No rain checks, may not be available at all store locations - call your local Jaycar store to check stock

AUDIO / VISUAL

HDMI TO VGA/COMPONENT AND LR ANALOGUE AUDIO CONVERTER

NEW

Easily view HDMI signals on analogue displays that use VGA or component inputs. Converts your PC monitor into the main display for a Blu-ray player or gaming console such a as PS3. It will also convert LR analogue audio with a 3.5mm socket for use with most PC speakers and headphones.

- Dimensions: 140(W) x 38(H) x 94(D)mm

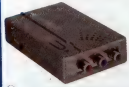
$149 Cat. AC-1605

Limited Stock

COMPOSITE VIDEO/S-VIDEO TO YCBCR/RGSB FORMAT CONVERTER

NEW

Designed for converting Composite video / S-video signal such as iPod®, DVD, X-Box® to the component RGsB for connecting to SDTV or projector. The simple plug and play unit automatically recognises the source system and has a power saving mode.



- Suitable for worldwide video system of NTSC3.58, NTSC4.43, PAL, PAL-M, PAL-N and SECAM
- Supports composite video and super video input
- 5VDC Power supply included
- 145(W) x 90(L) x 32(H)mm

$149 Cat. AC-1629

COMPONENT/S-VIDEO TO HDMI UPSCALER

Upscale component or S-video signals to HDMI. Allows you to output to a wide range of resolutions from 480p to 1080p. The unit will accept input from a composite video source, S-video source, 3.5mm audio source and output it to HDMI. LEDs on the front panel indicate what video source is being used and what resolution is being ouput.

- Motion adaptive 3D Y/C separation comb filter
- Scales up component video or S-Video to HDTV 1080p format
- Dimensions: 100(W) x 157(D) x 25(H)mm

NEW $299 Cat. AC-1627

Also available:
Component and Digital/Analogue Audio to HDMI Upscaler Cat. AC-1628 $369

RECTANGULAR CABLE DUCT

Available in two sizes and in convenient 1m lengths, the leads to your wall-mounted plasma or LCD TV will be kept bundled up but easily accessible. The cover can be quickly removed and replaced for maintenance and can be painted to match the colour of your wall.
25 x 16mm x 1m Cat. HP-1330 $6.95
50 x 25mm x 1m Cat. HP-1332 $9.95

NEW

HDMI LEADS WITH EXTENDER

Normally you can't run an HDMI cable over a maximum of about 5 metres without using a booster. These cables solve this problem by adding an extender to give you a range of 15 or 20m with no need for additional power. The connectors have gold plated contacts. HDMI 1.3 and HDCP compliant.
15m HDMI Lead with Extender Cat. WQ-7408 $139
20m HDMI Lead with Extender Cat. WQ-7409 $199

NEW

ECONOMY HDMI LEADS

HDMI leads can cost an arm and a leg. If your budget doesn't extend too far, these leads are a cost-effective solution without compromising quality or performance. All have gold plated connectors and are fully HDMI v1.3b and HDCP compliant.
WQ-7415 HDMI Lead Economy 1.5m $24.95
WQ-7416 HDMI Lead Economy 3m $34.95
WQ-7417 HDMI Lead Economy 5m $49.95

TOUCHSCREEN 8 IN 1 LCD REMOTE CONTROL

Use the learning function of the pre-programmed code library to enrol each component or use the macro functions to program up to 100 keystrokes. For each different device, the LCD backlight is colour coded for easy recognition and you can change the device key layout as you like. Requires 4 x AA batteries.

- Auto power-off after 10 minutes
- Low power indicator
- Size: 195(L) x 65(W) x 21(H)mm

$59.95 Cat. AR-1728

NEW

DIGITAL TOSLINK/COAX TO COAX/TOSLINK CONVERTER

NEW

Most equipment manufacturers use different digital audio input/output formats and cannot be easily interfaced with one another. With our handy little digital audio converter, you will never be caught out with the wrong digital audio connection ever again. It will convert digital audio from either coax or Toslink inputs and outputs to Toslink or coax. It also has a built-in amplification feature; it can serve as a repeater of audio signals and extend (double) the transmitting distance.

- LED power indicator
- Supports two-way conversion: Coaxial to Toslink or Toslink to coaxial.
- Compact and easy to setup
- Dimension: 42(W) x 40(D) x 22(H)mm

$59.95 Cat. AC-1601

TOSLINK DIGITAL OPTICAL 2 WAY SPLITTER

NEW

A digital optical 1-to-2 distributor featuring one Toslink input to two Toslink outputs. Mains power adaptor included.

Power Supply: 5VDC 500mA
Dimensions: 46(L) x 46(W) x 24(H)mm

$69.95 Cat. AC-1613

COAXIAL/OPTICAL TO ANGLED AUDIO CONVERTER

Connect a coaxial or optical (Toslink) audio source to this device and it will output to R/L composite analogue. Useful for connecting DVD/Blu-Ray players to displays or audio equipment that have no digital audio input.

- Integrated digital interpolator filter and D-A converter
- Stereo audio inputs
- Dimensions: 42(W) x 40.5(D) x 22(H)mm

NEW $69.95 Cat. AC-1603

ANALOGUE TO DIGITAL AUDIO CONVERTER

Convert a stereo analogue audio signal to coaxial and Toslink outputs simultaneously. It also supports uncompressed 2-channel LPCM (Linear Pulse Code Modulation) digital audio signal output with sampling rate at 48kHz. Both optical fibre and coaxial cables connected to the outputs of the unit can be run up to 5 metres whilst still providing a dependable and quality audio signal transmission.

NEW

- Audio delay (150 mir-seconds)
- Noise free transmission
- Easy to install and use
- Power: 5VDC power adaptor included
- Dimensions: 67(W) x 50(D) x 23(H)mm

$79.95 Cat. AC-1611

DIGITAL INDOOR/OUTDOOR ANTENNA

Attractive contemporary design providing high quality digital reception. The panel can be wall mounted to minimise space usage. AC adaptor included.

NEW

- Frequency range: VHF - 174-230MHz, UHF - 470-862MHz
- Antenna gain: 10dB
- Total gain: 40dB
- Impedance: 75 ohm
- Output: F female connector
- Dimensions: 502(L) x 235(W) x 76(H)mm

$99 Cat. LT-3137

EXCELLENT FOR UNDER EAVES, BALCONIES & APARTMENTS

8 WAY HIGH END POWERBOARD WITH SURGE PROTECTION

NEW

Ideal for home theatre and sensitive high-end gear. With surge protection, filtering and a built-in circuit breaker for 8 mains outlets, this powerboard also has protection for telephone (1 input, two outputs so doubles as a splitter), data/network connection, satellite/cable TV, and TV antenna. See website for details.

$99.95 Cat. MS-4029

2 Year $50,000 Connected Equipment Warranty

Better, More Technical

All savings are based on original recommended retail prices.

Gadgets, Tools & More

Robotic Chess Board

Equipped with a robotic arm and an enhanced high-speed program, it can teach you to play as well as improve your skills. Play against the Robot like a real opponent.

- Suitable for novice to experienced players
- 128 levels including training, tournament & problem solving levels up to mate-in-6 moves
- Programmed in accordance with the International Chess Rules
- Knows en-passant moves, castlings & pawn promotion
- Check, stalemate & checkmate announcement
- Board size: 380(W) x 360(D) x 40(H)mm

NEW

$299
Cat: GT-3516

1.3MP Digital Video Sports Camera

You could make your own action sports video! The camera straps onto your helmet and has a super-sticky adhesive mount to keep it in place. It has simple one-button operation to start recording and uses SD cards up to 32GB for storage. Mountain biking, skateboarding, BMX, skydiving, bungee jumping etc. Requires 2 x AAA batteries.

SAVE $20

Storage media: 32GB SD card
Video resolution: 640 x 480 @ 30 fps
Imaging sensor: 1.3MP
Dimensions: 90(L) x 50(Dia)mm
~~Was $119.00~~
Limited Stock

NEW

$99
Cat: QC-3238

Interactive Music Quiz

Test your family and friends' music knowledge with this interactive music quiz that you control! Game options include 'name that track', 'beat the intro', 'name the artist' and 'sing the next line'. Or make up your own game - the possibilities are endless!

- Speaker console with four team buzzers and LCD points display
- Quizmaster controller with music start/stop button, points buttons, crowd sound effects, three music distortion buttons and volume control
- MP3 player (not included) connection to the Quizmaster controller
- Requires 3 x AA batteries
- Suitable for ages 8+

NEW

$49.95
Cat: GE-4233

Mini 2 Channel IR Apache Helicopter

Mini 2 Ch IR Apache Helicopter with robust moulded plastic construction to take the inevitable bumps and occasional crash.

NEW

- 20 minute charge gives about 10 minutes flying time (recharges directly from the remote unit)
- Requires 6 x AA batteries
- 160mm long
- Recommended for ages 10+

$29.95
Cat: GT-3273

3 Channel Shark Helicopter with Alloy Frame

All aluminium airframe, fuselage and landing gear make this chopper more than a toy and suitable for outdoor flying in calm conditions. A great challenge for the more experienced pilot.

- Li-Po battery recharges in about 20 minutes to give about 10 minutes flight time
- Remote requires 4 x AA batteries.
- Trim control
- Pluggack charger included
- 380mm long
- Recommended for ages 14+

$79.95
Cat: GT-3380

NEW

6-in-1 Solar Educational Kit

Build any one of six different projects from the parts in the kit. No tools, soldering or glue required. All the parts snap together with spring terminals for the wiring. The instructions are excellent with extremely clear illustrations detailing every step. The finished projects are solar powered, but can also be powered by the light from a household 50W halogen light.

Projects:
- Windmill
- Car
- Dog
- Plane
- Airboat
- Revolving Plane

Suitable for ages 10+

$24.95
Cat: KJ-8926

NEW

Kitchen Scales with Clock & Temp/Humidity

NEW

Kitchen scales, clock and weather station rolled into one. It weighs contents in metric or imperial measure up to 3kg (6.6lb), and doubles as a wall clock that displays temperature and humidity. Funky orange design. Can sit on kitchen bench or be hung on the wall.
Requires 3 x AAA batteries.
- Celsius & Fahrenheit display
- Kg or lb
- Size: 200(Dia) x 22(H)mm

$44.95
Cat: XC-0161

LED Magnifier Lamp

Clearly see what you're working on with this multifunctional laboratory magnifier. Included is an extension pole that transforms it from a desk top unit into a floor standing unit; also included is a detachable desk-mounting clamp. Can be powered with the provided plug pack or 4 C size batteries which allows this unit to be used where mains is not available.

NEW

- 20 high-brightness LEDs
- 4 dioptre magnification
- 127mm diameter lens
- 1200mm floor mode height
- 600mm desk mode height
- Mains plugpack included
- Base measures: 310(L) x 230(W)mm

$99
Cat: QM-3542

Mini Keychain Speaker

This keychain speaker will distribute the decibels! Compatible with any device that features a 3.5 mm headphone socket such as iPods®, MP3 players, PDAs, portable games and computers. It comes with a USB connection to recharge the built-in battery. The ultimate in portability.

- USB and 3.5 - 3.5mm cable included
- Measures: 25(W) x 25(H) x 25(D)mm

NEW

$19.95
Cat: XC-9178

Pocket Wire Stripper

Strips anything from 2G to RG6 coax. Easy to use and small enough to take anywhere on the job.
- 120mm long

NEW

$14.95
Cat: TH-1817

Handheld USB 60X Microscope

A colour zoom CMOS video camera that is mounted in a microscope style housing. The system connects to your computer via the USB port and microscope images are viewed on your computer screen as either a snapshot or a video stream. Both can be saved for later viewing. The system has its own LED illuminators so there is always plenty of light for viewing. Accessories include specimen slides, eye dropper and tweezers.

- Up to 640 x 480 image resolution
- Maximum magnification 60X
- Size: 100(L) x 38(Dia)mm

$59.95
Cat: QC-3246

NEW

92 Piece 12V Rotary Tool Set

Drill, saw, sand, polish, carve or grind in your workshop or out on the road. 90+ bits and attachments cover every possible task you'll ever need. The rotary tool is rated for 12V at 12,000 RPM. Ideal for hobby or professional use. See website for full list of attachments

NEW

- Case size: 240(L) x 200(W) x 70(D)mm

$39.95
Cat: TD-2451

Computer Tool Kit

All the essentials for doing some minor surgery to your PC. Don't forget your anti-static strap.

Kit contents:
- Driver bit handle
- Bits: Slotted 3mm, 4mm, PH 0, 1,T10, T15
- Hex adaptors: 4mm, 5mm, Tweezers, IC extractor, Pearl catch

NEW

$19.95
Cat: TD-2190

Massive Savings on Clearance Lines 10% to 70% OFF

Listed below are a number of discontinued (but still good) items that we can no longer afford to hold in stock. We need more space in our stores! You can get most of these items from your local store but we cannot guarantee this. Please ring your local store to check stock. At these prices we won't be able to ship from store to store.

Items will sell fast and stock is LIMITED - ACT now to avoid disappointment — **Sorry - NO Raincheks**

SECURITY PRODUCTS CLEARANCE

Description	Cat No.	WAS	NOW	SAVE
20 Metre 4-Pin DIN to Video/Power Lead	QC-3097	$29.95	$19.95	$10.00
4 Input USB Video Recorder	QC-3089	$149.00	$79.00	$70.00
4 Zone Wireless Alarm Kit	LA-5134	$89.95	$59.95	$30.00
Balun CAT5 5-Video	QC-3423	$49.95	$29.95	$20.00
Balun Component Video CAT5	QC-3692	$49.95	$24.95	$25.00
Bellbox with Siren & Strobe Weatherproof 12VDC	LA-5309	$29.95	$17.95	$12.00
Camera 1.4GHz Pan/Tilt with Handheld Monitor	QC-3279	$399.00	$269.00	$130.00
Camera CMOS Colour Intrared Bullet	QC-3097	$99.00	$55.00	$44.00
Camera CMOS Colour with Inspection Gooseneck	QC-3389	$199.00	$109.00	$90.00
Camera Dome B&W 380TVL OCD	QC-3472	$89.00	$59.00	$30.00
Camera Dome Kit (2 Mini Cable & PSU)	QC-3264	$129.00	$85.00	$44.00
Camera Kit 2.4 GHz Mini Wireless CMOS	QC-3569	$199.00	$129.00	$70.00
Camera Outdoor (PS?) IR B&W 380TVL COD	QC-3490	$169.00	$99.00	$70.00
Camera Outdoor Bullet (PS?) B&W 380TVL COD	QC-3497	$99.00	$59.00	$40.00
Camera Outdoor IP57 IR Colour with 2-Wire Kit	QC-3286	$149.00	$100.00	$49.00
Camera Pro B&W 380TVL COD	QC-3312	$109.00	$69.00	$40.00
Camera Pro Colour 380TVL COD	QC-3288	$249.00	$169.00	$80.00
Camera PTZ Dome Colour 480TVL COD	QC-3500	$649.00	$449.00	$200.00
Camera Wireless 2.4GHz CMOS Colour 4CH	QC-3565	$189.00	$99.00	$100.00
Camera Wireless 2.4GHz CMOS Colour IR 420TVL 4CH	QC-3284	$299.00	$159.00	$140.00
Camera Wireless 5.8GHz CMOS Colour	QC-3571	$179.00	$79.00	$100.00
Camera Wireless 5.8GHz CMOS Colour CH3 with PSU	QC-3570	$199.00	$82.00	$120.00
Camera Wireless 5.8GHz CMOS with IR Colour	QC-3570	$259.00	$119.00	$150.00
Camera Wireless PC/P/Network 6 x IR MPEG4	QC-3398	$349.00	$199.00	$150.00
Camera/Receiver Wireless 5.8GHz CMOS Colour 4CH	QC-3572	$299.00	$149.00	$150.00
Dual Output Video Distribution Amplifier	QC-3438	$99.00	$59.00	$30.00
DVR Economy MPEG4 4CH w/ 250GB HDD & Ethernet	QV-3079	$849.00	$399.00	$250.00
DVR SD with 2 x IR Colour Camera Kit with PSU & Leads	QV-3098	$349.95	$159.95	$190.00
Long Range AV Transmitter	QC-3425	$179.00	$99.00	$80.00
PIR Child / Pet Door Annunciator	LA-5166	$49.95	$25.95	$24.00
Receiver Wireless 2.4GHz Module Small Footprint	QC-3599	$29.95	$17.95	$12.00
RF Modulator for Audio & Video	LM-3872	$18.95	$9.95	$9.00
RFID Keypad Access Controller	LA-5123	$169.00	$64.00	$105.00
Spare Extender/Repeater Sensors for Wireless Alarm Kits	LA-5139	$54.95	$37.95	$17.00
Spare Remote Control for 8 Zone Alarm (LA-5477)	LA-5479	$24.95	$11.95	$13.00
Wall Plate balun VGA to RJ45	LT-3034	$149.00	$69.00	$80.00
Wireless Strobe & Siren with Solar Charger	LA-5301	$199.00	$139.00	$60.00
8 Zone 2 Wire Alarm Kit	LA-5477	$149.00	$99.00	$50.00

LIGHTING & OUTDOORS CLEARANCE

Description	Cat No.	WAS	NOW	SAVE
Headtorch Dynamo Powered	ST-3346	$23.95	$6.95	$17.00
Headtorch Waterproof Diving 30m 8 x LED	ST-3074	$59.95	$29.95	$30.00
Pest Repeller Ultrasonic High Power	YS-5524	$169.00	$115.00	$54.00
Pest Repeller Solar Recharge - Blue	YS-5532	$29.95	$13.95	$16.00
Portable Jaffle Iron 240VDC	YS-2808	$99.95	$19.95	$80.00
Portable Stove 240VDC	YS-2807	$49.95	$34.95	$15.00
Solar Lighting System w/ 2 Lights	MP-4551	$189.00	$119.00	$70.00
Solar Powered LED Bicycle Tail Light	ST-3276	$23.95	$12.95	$11.00
Torch 6-in-1 Dynamo with Radio & Siren	ST-3373	$59.95	$32.95	$27.00
Torch Keyring Dynamo Powered	ST-3348	$12.95	$3.50	$8.45
Torch LED 1.5W	ST-3332	$34.95	$19.95	$15.00
Torch Solar Rechargeable	ST-3077	$29.95	$14.95	$15.00

POWER PRODUCTS CLEARANCE

Description	Cat No.	WAS	NOW	SAVE
Mains Dimmer with Panel 240V 400VA	PS-4082	$29.95	$19.95	$10.00
Powerboard 6 Way with Phone Line Filter	MS-4036	$33.95	$19.95	$14.00
Powerboard 8 Way Master/Slave with Phone Line Filter	MS-4082	$64.95	$44.95	$20.00
Solar Mobile Charger with Detachable Solar Panels	MB-3588	$69.95	$34.95	$35.00
Universal Mains Charger for iPod®	MB-3662	$29.95	$18.95	$11.00

Quad Processor with 2 CMOS Colour Cameras & Remote Control

Add a monitor or plug into your TV and you have a complete surveillance system. With 2 colour IR cameras, this processor turns any standard TV or monitor into a multiplexer. It can display a single camera view, or multiple combinations of different camera views including one or two picture-in-picture or automatic sequencing.

Was $349

$149 Cat: QV-3095 — SAVE $200

Fingerprint ID Access

One unit can be used to control a single door or access point, or multiple units may be used on a site and connected to a PC via RS232, RS485 or Ethernet connection. In addition to controlling a door strike, the controller can also control an alarm to alert of any attempt to force entry or tamper with the unit. Up to 500 users can be enrolled and each can have access restricted to certain times. Software included.

- 12VDC 3A relay output
- Requires 9VDC @ 500mA
- Dimensions: 180(L) x 82(W) x 55(H)mm

Was $499

$299 Cat: LA-5121 — SAVE $200

Handheld Micro Inspection Camera

The new Digitech handheld micro inspection camera allows you to perform a detailed visual inspection in hard to reach areas. Its pistol grip design and detachable 2.4GHz monitor make it easy to locate and diagnose the unreachable.

Camera:

- image sensor: CMOS
- Resolution: 704 x 576 pixels

Monitor:

- LCD Screen Type: 2.5" TFT-LCD
- Effective pixels: 480 x 240

$299 Cat: QC-8700 — NEW

Economy 4 Channel H264 DVR

A combined multiplexer and digital video recorder that delivers quality image reproduction at a touch of a button. It accepts up to 4 video inputs and its incorporated Ethernet capability enables the unit to be accessed (without password protection) via the internet via a standard web browser. The unit features H264 compression, VGA monitor connection, motion trigger recording, video loss detection, remote network record and USB back-up support. The unit comes fitted with a 250GB HDD and includes software & manual disc, power supply and quick start guide.

- Size: 343(W) x 59(H) x 223(D)mm

Also available:
Economy 16 Channel MPEG-4 DVR with 500GB Hard Drive
Cat. QV-8102 $999

$599 Cat: QV-8101 — 250GB HDD Included — NEW

YOUR LOCAL JAYCAR STORE

Australia Freecall Orders: Ph 1800 022 888

NEW SOUTH WALES

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Bondi Junction	**Ph (02) 9369 3899**
Brookvale	**Ph (02) 9905 4130**
Campbelltown	**Ph (02) 4620 7155**
Coffs Harbour	**Ph (02) 6651 5238**
Croydon	**Ph (02) 9799 0402**
Erina	**Ph (02) 4365 3433**
Gore Hill	**Ph (02) 9439 4799**
Hornsby	**Ph (02) 9476 6221**
Liverpool	**Ph (02) 9821 3100**
Newcastle	**Ph (02) 4965 3799**
Penrith	**Ph (02) 4721 8337**
Rydalmere	**Ph (02) 8832 3121**
Sydney City	**Ph (02) 9267 1614**
Taren Point	**Ph (02) 9531 7033**
Tweed Heads	**Ph (07) 5524 6566**
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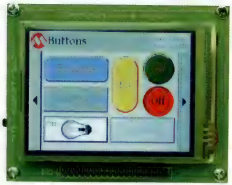

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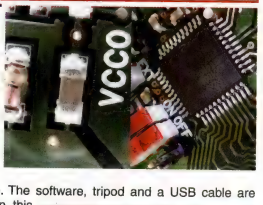

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SERVICEMAN'S LOG

Relay standards: there's no such thing

Can a standard 4-pin 12V relay be all that difficult to diagnose? Well, not really but you can really be caught out if you assume that all relays conform to the same standard, particularly in the automotive trade.

Items Covered This Month

- Relay standards – no such thing
- Resurrecting a PC

My first story this month is from my friend in the automotive trade and concerns an interesting relay fault in an old Ford. I'll let him tell it in his own words . . .

We recently had an old car into the workshop with a "battery drain" problem. The symptoms were simple enough. If the car was left unused for more than 36 hours, the battery didn't have enough charge remaining to start the car.

The car in question was a 1976 XB Fairmont. These old girls are now so ancient that they qualify for HCRS (Historic Concessional Registration Scheme, in NSW) or in plain English, "Vintage Rego". Now I really do feel old!

This was a classic case of an older technician passing a supposedly simple job to a junior "new-age" technician, thinking that he could see firsthand how simple cars once were. The only electronics on board a 1976 Ford are inside the (AM) car radio and the 35A alternator. There was no EFI, ABS, ECU, sat-nav or burglar alarm. In fact, this car didn't even have air-conditioning or power steering. And while it was light-years ahead of a 1953 FJ Holden, this 1976 Ford illustrates just how far we have come in the last 33 years.

Anyway back to the problem at hand. With a car this simple, how easy would it be for our young tech (let's call him John) to solve a problem as mundane as the battery going flat? Admittedly, this was on an older car that he wasn't familiar with but it should all be routine.

Well, at least it started out well. He first carried out a battery load test and then checked the alternator charge rate to verify that that side of the system was all good. John then quickly found that with all the Ford's electrical devices switched off, his multimeter indicated a constant current drain of more than 180mA from the battery.

From there, his next step was to check that all the usual suspects were definitely off. By "usual suspects" I mean those little convenience items such as boot lights, glovebox lights and other "courtesy" features that cause so much grief in draining car batteries if they're not working properly.

In fact, in my experience, these "convenience" items can be very inconvenient at times.

The only item on board that should be drawing current with all systems shut down is the clock but these old-school mechanical timepieces don't draw current continuously. Instead they "wind up" as and when required, so for the majority of the time their current draw is zero. Remember, this was before the days of electronic radio station presets and all manner of other memory-based devices.

John's next step was to remove each of the fuses in the fusebox. This is done on a one-by-one basis while checking the current drain at the battery, to see which branch is at fault. And yet, with all the fuses extricated, we still had a 180mA constant drain which was a real surprise, especially as these old Fords were quite well designed electrically.

A quick check of the

wiring schematic showed that the only items remaining in circuit, with all fused circuits disabled, were the starter motor and the alternator. We then took a closer look at this area and this revealed that some aftermarket wiring had been added to the alternator output terminal, to supply a pair of auxiliary driving lights.

This extra wiring had been fitted decades ago, probably by the selling dealer's workshop when the car was new. The workmanship was top-notch, obviously performed in a more leisurely era when labour rates were something like $10 per hour and a tradesman's pride took precedence over a "quick buck". In fact, it looked so good to John that he had assumed it to be factory-installed.

These days, any aftermarket wiring is immediately suspect. It is generally a little untidy (by comparison) and far more likely to cause a problem than any part of the factory harness.

The driving lights were powered directly from the alternator output via a relay. This relay was switched by a dash-mounted toggle switch which in turn was switched by the high-beam column stalk.

The relay utilised was the common garden-variety Bosch 4-pin unit that has been used in the industry for at least four decades. In this case, it was installed in a chassis-mount socket that had been attached to the inner guard, adjacent to the alternator. This meant that the relay could be simply unplugged from its socket, if required, so John did just that to reveal a sudden drop in battery drain.

Eureka! – but what was the cause. After all, 4-pin relay wiring doesn't come much simpler? There's just a 12V supply, an earth, a switching wire from the dash and a wire to the lights themselves. All these circuits checked out individually but – and it's a big but – John failed to notice that while the driving lights still worked, the relay didn't "click" as it should have when switched on.

At this point, he asked me for help as he had run out of ideas. In fact, I have taught John to ask for help if required, especially when I'm charging my clients $100 per hour plus GST for his time on the job. How many times have you had to "trim" the figures on a job sheet because time has been spent on a wild goose chase and it isn't possible (or ethical) to charge the client for that portion?

I immediately noticed two things. First, as already mentioned, the relay wasn't making an audible "click" when the driving lights were switched on and second, the relay itself was brand new. I noticed this "newness" because about the only design change that Bosch has made to these relays in the last few decades is that they now use a black plastic casing, whereas the older style relays were built into a zinc-plated pressed metal case.

And that's when the penny dropped, or was it a case of deja vu. The root cause was that somebody had quite recently fitted an incorrect replacement relay. It still plugged into the socket correctly but the connections were now electrically "incorrect".

In the automotive industry, one thing I have learnt is that the word "standard" doesn't necessarily mean "standard", because everyone has their own "standard". The problem is that these particular relays come in two different base configurations. In other words, there's one base layout but two different configurations. Confused yet?

The base on the original relay fitted to the Ford has pins 30, 85, 86 & 87 as shown in Fig.1. Pins 85 & 86 are the coil connections, while pins 30 & 87 are the relay contacts. This base layout was common in the 1970s but is still seen on occasions.

Fig.1: the base layout of the relay originally fitted to the old Ford Fairmont for the driving lights. Note the locations of pins 30 & 86.

Fig.2: the base layout for the replacement relay. Both relays use the DIN standard pin numbering scheme (and they fit the same socket) but the locations of pins 30 & 86 are transposed (the layout in Fig.2 is now the most common).

The more recent layout is shown in Fig.2. As can be seen, both relays use the DIN standard pin numbering but the locations of pins 30 & 86 are transposed.

And so, with the new relay plugged in, the full-time 12V supply (from the alternator) held the relay "on"

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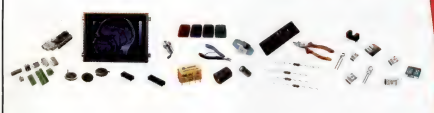

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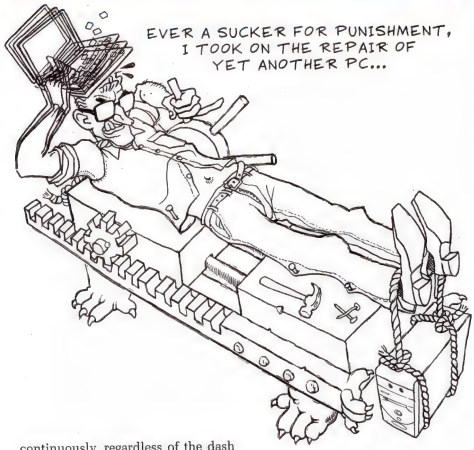

continuously, regardless of the dash switch operation. The driving lights were still switched on and off by the dash switch but the relay's purpose in life was negated.

In fact, the poor old dash switch was probably working at or near its maximum current rating, trying to supply the driving lights. Meanwhile the relay was being held on 24 hours a day drawing 180mA, conveniently (or rather inconveniently) draining the battery. We replaced the relay with the correct type and the old Ford was back in business.

So that's life sometime in the automotive business. It really is easy for something simple like that to waste a lot of time.

Now for one of my own stories. Despite my hassles, I certainly didn't make any money out of this one.

Ever a sucker for punishment

Ever a sucker for punishment, I took on the repair of yet another PC, this time for a friend. I've really got to stop doing this; PCs can be a great time-waster. The only trouble is, repairs to CRT TV sets have all but ceased and I've got to make money somehow.

The unit in question was a Dell Optiplex CX620 that my friend purchased at an auction. Apparently it was an ex-university computer which he bought cheap, sight unseen. Its hardware specifications weren't too bad and included a 3.2GHz Intel P4 CPU, 1GB of RAM and a 160GB SATA 7200RPM hard drive. It also boasted a good AGP video card with a DVI socket.

Eventually, when I found time, I hooked it up to a monitor, USB keyboard and mouse and fired it up. It turned out that the computer was configured to work on a network which had multiple user names, passwords and devices to select. I selected "Administrator" and the name of this computer but I didn't know the password so I was stuck.

In the end, I had to dig out my Offline NT Password & Registry Editor utility. This is a Linux utility which goes on a CDROM boot disk. When you boot the machine, it automatically takes you into the *C:\windows\system32\config\sam* configuration file and allows you to edit the hives passwords and permissions and to reset the counters. I set the password to blank for the Administrator and now I could boot up into XP Pro after hitting CTRL + ALT + DEL to log on.

The next thing to do was to interface it to my wireless router via a USB2 dongle (Hawking HWUS4G 802.11g Mini Wireless LAN). I then got onto the Internet and downloaded the latest Dell drivers and patches, as well as the Microsoft Updates. And that was when I found I was in all sorts of trouble.

The security settings in the machine were all wrong and what's more, I couldn't edit them. I couldn't set the machine for automatic updates and I couldn't do much with the User setting either.

I got onto the Microsoft Update site and noticed that after downloading the X86 32-bit Windows Update Agent I got an error code: OX8024D007. I was also getting "Chassis Intrusion Detected" error messages as well. The only thing I could successfully download was from the Dell website and I noticed that the BIOS I had was A03 and the current version was A11, so I thought this would be a good place to start.

Well, true to form I was wrong – very wrong. I followed the instructions very

Servicing Stories Wanted

Do you have any good servicing stories that you would like to share in *The Serviceman* column in SILICON CHIP?

If so, why not send those stories in to us? In doesn't matter what the story is about as long as it's in some way related to the electronics or electrical industries, to computers or even to car electronics.

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carefully but when it came to rebooting, it didn't! All I got was solid green LEDs 3 & 4 and a 3-1-2 beep code during POST (Power-On Self Test). According to the manual, this implied either a RAM problem or a Master DMA register failure.

I tried swapping the RAM over but nothing I did would let me boot the machine. I even removed the video card and used the on-board VGA socket but no luck.

I then trawled the web on my own computer but I couldn't find anything sensible and practical. And then I had an idea. I turned the computer off, unplugged it from the mains and removed the back-up battery for half an hour. I then replaced everything and switched it back on.

It rebooted, much to my relief, so I got into the new BIOS and reset the intrusion alarm. That was one annoying problem solved.

Back in Windows, I opened Internet Explorer and noticed it was still version 7.0. I couldn't use Windows Update but I could separately download IE 8.0 from the Microsoft Download Site. I did this but it took three attempts before it installed correctly! This machine clearly had a few issues.

This time, when I rebooted and went back into IE 8, Microsoft Updates was now working properly and I was able at last to download the 30 or so updates that were available. And with each succeeding update, the machine gradually came good.

Booting and closing down had previously been a bit of a problem. To close down, I always had to log off first because the option to go straight to shut down wasn't coming up. Similarly, the option to restart the machine had also gone AWOL. With the updates, this was now all fixed but I could not switch off the log-on procedure (ie, CTRL + ALT + DEL) until I rediscovered "Powertoys" for XP. This is a series of useful utilities, including one called "TweakUI".

Using this, I was able to make the computer boot straight into Windows and close down/restart properly as per normal. But I was not completely out of the woods yet. Microsoft Updates would not let me install MS SQL Server 2005 Express Edition and instead left me with an error code.

Surprisingly, aid came from an unexpected quarter. Forgive me if I appear quite cynical when it comes to software help, let alone Microsoft Help, but when I emailed Microsoft they were actually extremely helpful. The assistance even had a distinct Indian flavour, with beautifully polite and correctly-written English prose!

My Indian friend suggested I remove all of MS SQL Server 2005, the KB960089 security update, Compact Edition (ENV), Native Client, Support Files and VSS Writer (just removing the main program doesn't fix it). The advice was to then reboot and download and reinstall MS SQL Server 2005 again.

I did that, then rebooted and then ran MS Update again. And this time, XP Service Pack 3 (SP3) installed correctly.

The computer now works well but I don't think my mate really deserves me putting up with all this grief! In hindsight, it probably would have been a damn sight quicker to reformat the hard drive and reinstall everything.

When will I ever learn not to take on PC repairs? **SC**

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A precision Temperature Logger and Controller, Pt.1

By LEONID LERNER

This Temperature Logger & Controller is based on the Dick Smith Electronics Q1437 digital thermometer. It records & displays two temperature channels once a second on a PC over a period of up to 12 hours. With appropriate thermocouples, temperatures from -200°C to +1300°C can be recorded, with the display range, resolution, and temperature program adjustable in real time while the data is being logged.

AS WELL AS PROVIDING precise temperature logging, the project will control a 230V AC heater rated up to 10A, in response to the temperature readings in on/off mode and a time-temperature regime set with up to four set points.

The accuracy of the instrument is 0.1% (excluding probe error) and its precision is 0.1°C over the entire range. The logger/controller interfaces to your PC through the parallel port using a standard DB25 connector.

The precursor to this project was the PID Temperature Controller featured in the July 2007 issue which in turn was based on the Digital Thermometer/Thermostat featured in the August 2002 issue of SILICON CHIP and previously available as a kit from Dick Smith Electronics.

That kit project has long been discontinued which made this comprehensive update necessary.

This new project dispenses with the original microcontroller and its associated circuitry from the July 2007 design, with all functions now performed by the attached PC. This significantly simplifies hardware construction which now involves soldering less than a dozen discrete components.

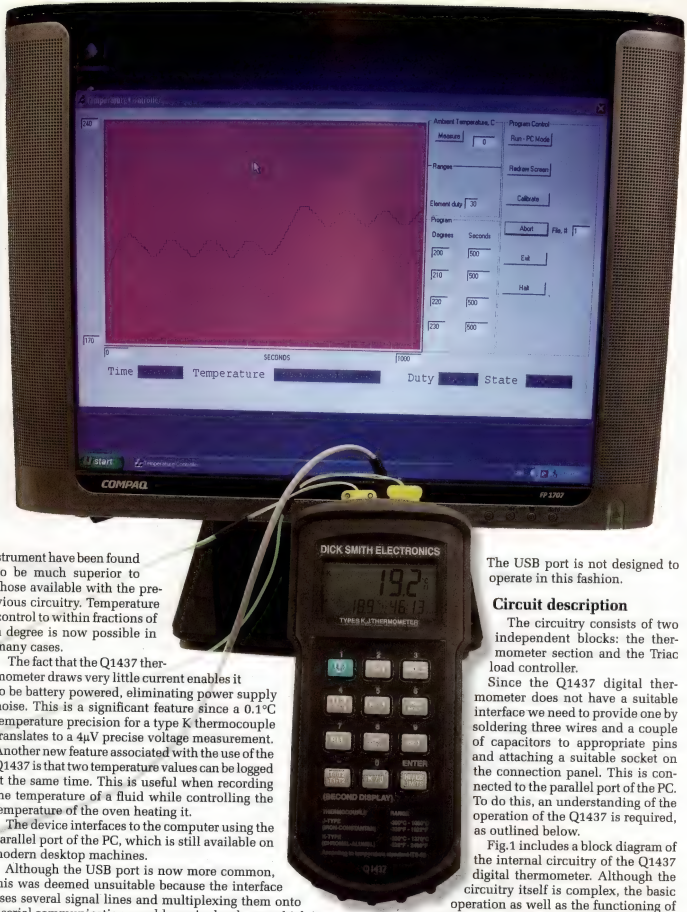
The down-side in eliminating the microcontroller is that the device can no longer be operated stand-alone.

In practice, this is not a serious inconvenience since the controller will mostly be used in the temperature logging mode, with the operator observing variations in real time. In this mode, the role of the microcontroller was, for the main part, that of a communications device.

Its other functions, such as controlling the analog-to-digital converter (ADC), are now performed by the DSE Q1437 digital thermometer, while the Triac control signal is generated by the PC.

The improvements arise from the fact that temperature readings are now logged with the accuracy and precision of the DSE Q1437 digital thermometer. This is a professional instrument and is based on modern microprocessor technology with a super low-noise ADC and custom ambient temperature compensation circuitry, which will be described in greater detail below.

The accuracy, reproducibility and noise level of this in-



strument have been found to be much superior to those available with the previous circuitry. Temperature control to within fractions of a degree is now possible in many cases.

The fact that the Q1437 thermometer draws very little current enables it to be battery powered, eliminating power supply noise. This is a significant feature since a 0.1°C temperature precision for a type K thermocouple translates to a 4μV precise voltage measurement. Another new feature associated with the use of the Q1437 is that two temperature values can be logged at the same time. This is useful when recording the temperature of a fluid while controlling the temperature of the oven heating it.

The device interfaces to the computer using the parallel port of the PC, which is still available on modern desktop machines.

Although the USB port is now more common, this was deemed unsuitable because the interface uses several signal lines and multiplexing them onto a serial communication would require hardware which is almost entirely absent in a parallel port design.

Moreover the logger captures data by running the PC for a very short period in "real-time"(ie, by disabling interrupts). The USB port is not designed to operate in this fashion.

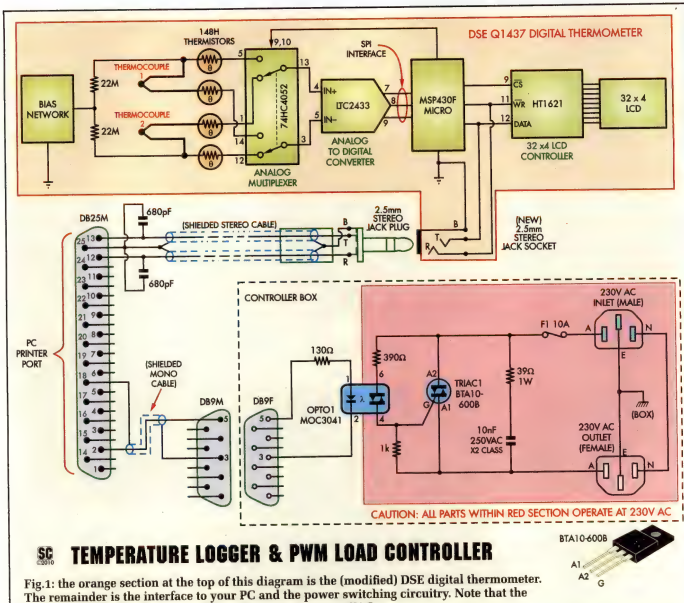
Circuit description

The circuitry consists of two independent blocks: the thermometer section and the Triac load controller.

Since the Q1437 digital thermometer does not have a suitable interface we need to provide one by soldering three wires and a couple of capacitors to appropriate pins and attaching a suitable socket on the connection panel. This is connected to the parallel port of the PC. To do this, an understanding of the operation of the Q1437 is required, as outlined below.

Fig.1 includes a block diagram of the internal circuitry of the Q1437 digital thermometer. Although the circuitry itself is complex, the basic operation as well as the functioning of the interface, can be easily understood.

Differing temperatures between the junctions of the thermocouples TC1 and TC2 and their connections at the instrument generate a voltage difference and this is ap-



TEMPERATURE LOGGER & PWM LOAD CONTROLLER

Fig.1: the orange section at the top of this diagram is the (modified) DSE digital thermometer. The remainder is the interface to your PC and the power switching circuitry. Note that the parts & wiring in the red shaded section all operate at 230VAC.

plied via custom thermistors (148H) to the inputs of the 74HC4052 analog multiplexer.

If the thermistors were not present the thermocouple circuit would give zero voltage when the thermocouple junction is at ambient temperature, rather than at 0°C.

The four thermistors and associated bias circuitry act to compensate for this by adding a potential difference with increasing ambient temperature in such a way that the total voltage behaves as if the reference end of the thermocouple circuit was held at a constant 0°C.

Next, the voltages generated by thermocouples 1 and 2 appear in turn at the outputs of the 74HC4052 analog multiplexer in response to signals sent by the MPS430F microcontroller. These voltages are applied differentially to the IN+/IN- inputs of the LTC2433 low-noise (1.45µV RMS) 16-bit delta-sigma ADC (analog-to-digital converter). This ADC can operate at reference voltages as low as 100mV and has a correspondingly low 5µV offset.

In addition, it is ultra-linear with a maximum 0.16 LSB full-scale error and also incorporates integral 87dB (factor of 22,000) notch filters at mains frequency (50Hz and 60Hz).

The converted digital temperature signal is passed serially via a 3-pin interface (pins 7, 8 & 9 of the LTC2433) to the MPS430F microcontroller. This is a very low power (280µA active, 1.6µA stand-by, 0.1µA RAM-retention mode) 16-bit microcontroller in a 64-pin QFP (quad flat package). The controller has three main functions: it reads the keyboard, gathers voltage data from the ADC, translates the data to temperature and passes it for display to the

WARNING!

Most of the parts in this circuit operate at high voltage (ie, 230V AC) and contact could be lethal. Do not touch any part of the circuit while it is plugged into the mains and do not operate it outside its earthed metal case (see Pt.2 next month).

Do not build it unless you are experienced and know exactly what you are doing.

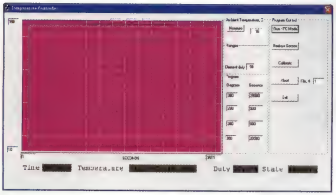


Fig.2: the GUI is quite intuitive and you should have no problems driving it.

HT1621 32-character 4-line LCD controller. This transfer is performed by means of three lines acting as inputs on the HT1621: the CS-bar (chip select) line, the WR-bar data write line and the data line.

As evident from its 32x4 specification, the HT1621 contains a 128-bit RAM which it reads out sequentially at a rate fixed by an internal clock and outputs on multiplexed lines which drive the liquid crystal display (LCD). These 128 bits correspond to elements on the Q1437 LCD and are distributed essentially randomly, as this display does not correspond to a 32x4 format.

The input side of the HT1621, which is independent of the output, is used to update the 128-bit data when new values are required.

Different command modes are available to either update the data as a single 128-bit block or as individual values. The Q1437 uses the former mode exclusively, so the block of data written to the HT1621 is always of a fixed size – 173 bits. The extra 45 bits sent in each frame take the form of three 12-bit commands to initialise the HT1621 and a 9-bit command to instruct single block update.

While the requisite bits are presented on the data line (pin 12), the WR-bar line driven by the microprocessor acts effectively as a clock, with a rising edge indicating good data on the data line. This signal is used by the software component of our interface to sense when to read the data.

Data update on the input side of the HT1621 occurs fairly slowly at a rate of about eight updates per second, however the data itself is transmitted quickly with each data bit about 1.5µs wide. At this frequency, the effects of reflections due to inductance on the line connecting the Q1437 to the PC are significant and can result in false readings. The addition of 680pF capacitors between signal and ground on both the DATA and WR-bar lines at the parallel port input of the PC suitably damps the oscillations and provides reliable operation, with no false readings using a simple 2-core shielded cable connection.

Triac load controller

The load controller is an opto-coupled Triac circuit with an RC snubber to reduce overshoot for inductive loads. The MOC3041 zero-crossing Triac driver minimises electrical noise and surge current when loads are close to resistive. The MOC3041 requires a current of 15mA to ensure turn-on and this is easily sourced from a single pin of the parallel port by a 130Ω resistor, dropping a nominal 2V.

Triac switching is achieved in software by toggling pin

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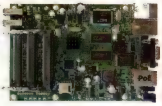

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Parts List –Temperature Logger and PWM Load Controller

1 Dick Smith Electronics Q1437 digital thermometer
1 PC board, 87 x 54mm, code 10101101
1 diecast aluminium case, Jaycar HB5040 to suit
1 IEC 3-pin male chassis-mount socket
1 IEC 3-pin female chassis mount socket
1 M205 safety fuse holder (Altronics S-5992, Jaycar PP4005)
1 10A M205 fuse
1 25-pin DB25M plug
1 9-pin DB9M plug
1 9-pin DB9F socket
1 2.5mm stereo jack socket and matching jack plug
1 BTA10-600B 600V 10A insulated tab Triac (do not substitute)
10 Nylon cable ties
1 MOC3041 zero-crossing Triac opto-isolator (OPTO1)

Capacitors
1 10nF 250VAC class X2
2 680pF ceramic

Resistors (0.25W, 1% unless stated)
1 1kΩ 1 390Ω 1 130Ω 1 39Ω 1W 5%

Miscellaneous
1 solder lug, mains-rated cable, ribbon cable, 2-core shielded cable, sing-core shielded cable, heatshrink tubing, screws, nuts, lockwashers, solder.

2 of the parallel port, which drives the MOC3041 optoisolator. The Triac on-period is nominally set to one second, as established by the timer function of the Windows API.

Since Windows is not a real-time operating system, precise timing can not be guaranteed, with a variation of typically 10% occurring in pulse width from cycle to cycle. This is not a problem for this present application since average duty cycle is still maintained to about 5%, while on/off control is the main mechanism by which temperature is controlled, with duty cycle being a secondary control applied manually to reduce overshoot.

Software

There are two components to the project software. The main component is written in Visual C++ and provides the graphical user interface (GUI) to the device, which can be seen in Fig.2. It also analyses the data block acquired from the Q1437 digital thermometer, extracts the data corresponding to the two temperature channels, displays the temperature on the screen and graphs the data using the scales entered by the user.

In addition, it operates the Triac load controller in accordance with the time-temperature program entered in the GUI.

The second component consists of the data block capture routine and is written in assembly language. The reason for this is that the bit-width of the data frame is about 1.5µs, which is close to the 1µs response time of the standard parallel port, hence speed is of the essence for proper operation. In addition, code running under Windows is periodically interrupted to perform task switching, which if allowed in the course of data capture leads to missing bits and data corruption.

Critical tasks can disable interrupts (except non-maskable interrupts) during their execution and restore them on completion and this does not interfere with Windows provided the task is brief. In our case, field acquisition takes up about 1ms with a period of about 1Hz, which is acceptable.

For PCs running Windows 95/98, the above code presents no particular problems and the low-level assembly routine can be linked as part of the overall application.

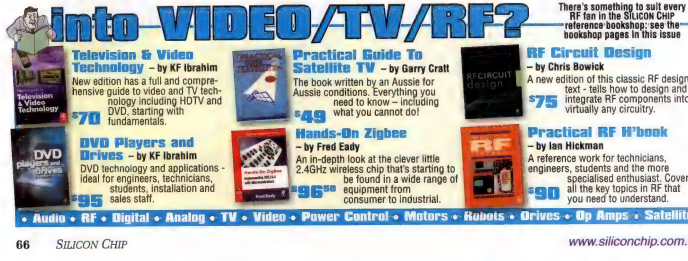
However, in later Windows versions, in particular Windows NT, XP etc, ordinary applications cannot suspend interrupts, while direct port access to individual applications can only be granted by code running at operating system privilege (ring-0).

Moreover, in Windows XP, changes made to the IOPL flag bits controlling port access at ring-0 level are restored by the operating system upon return to the application, making these flags essentially redundant.

For this reason, the assembler code is incorporated in its entirety into a device driver file (.sys file), which is installed and registered the first time the main program is run, subsequently performing access to the ports and passing data to the main routine.

What's coming?

That's all we have space for this month. Next month, we'll show you how to wire up the interface to the digital thermometer and give the full construction details for the Temperature Logger & Controller. SC



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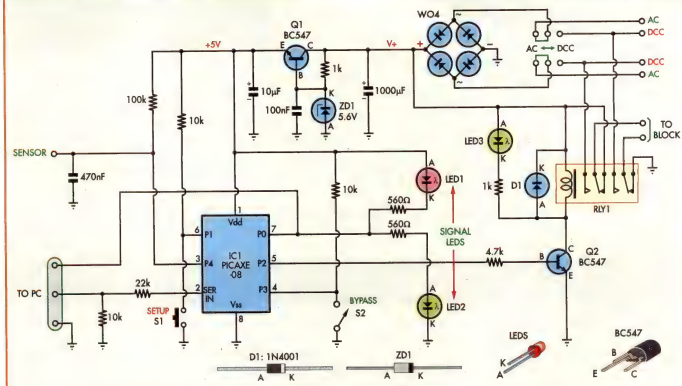
01/10

CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.



PICAXE-controlled slow-down for DCC model trains

This PICAXE-controlled track switching circuit takes advantage of the "slow on DC" feature that most DCC (Digital Command Control) decoders have these days. When enabled, this feature will slow a train to a stop when the track signal changes from DCC pulses to pure DC. By detecting the presence of a train and then changing the track voltage from the DCC signal to DC, the train can be made to slow down and stop.

Every DCC decoder has CVs (Configuration Variables) which are in the software and accessible by the operator. Most DCC systems allow the operator to program the CVs and as well as this there are a few standalone CV programmers available.

The rate at which the train decelerates and then accelerates away is controlled by two CVs. CV3 controls the acceleration and CV4 the deceleration. All the user has to do is isolate a block of track at the required stopping point. An optical sensor placed at the start of the block will switch the voltage within the block to DC. After a few seconds delay (user-settable), the track signal is switched back to DCC and the train moves off. The result is quite realistic to watch.

Install the optical sensor so that the block beginning is about two metres (depending on your layout size) from the required stopping point. A 2-aspect signal should also be placed at this point. Using trial and error, program the decoder's CVs to stop the train at the signal.

Place the optical detector about 1.5 loco lengths in from the isolated join. Now it is time to set the required stopping/wait time. Place the train a metre or two before the beginning of the block. Press and release the set-up button and then start the train. When the train crosses the isolated join, press and release the set-up button again. The train will now slow and should then stop at the signal. When you are satisfied with the stationary time press and release the set-up button again. The track will now go back to DCC and the train will move off. The time just set is now stored in the PICAXE's memory and will be loaded next time the system boots up.

The unit will go to normal mode and that is it. Each time the train crosses the sensor it should slow and stop at the signal which is red. After your set time the signal will change to green and the train will move off.

Note the alternative power arrangements for the circuit. As shown, the links at the top right-hand corner allow it to be powered from low voltage (eg, 12VAC) from a separate transformer or from the DCC voltage applied to the track.

The software for the PICAXE (DCC_Auto_stop.BAS) will be available on the SILICON CHIP website.

Jeff Monegal,
North Maclean, Qld. ($45)

Simple battery tester uses quartz clocks

I have found quality problems with some rechargeable NiMH AA and AAA batteries. While Sanyo's Eneloop and Varta AA batteries are very close to their marked or rated capacity, tests on a number of batteries of other makes indicate that the capacity marked on them in mAh appears to be imaginary and is not to be believed.

What adds to the problem is the variation in capacity between individual batteries of the same make and type, even when purchased together, sometimes in 4-packs.

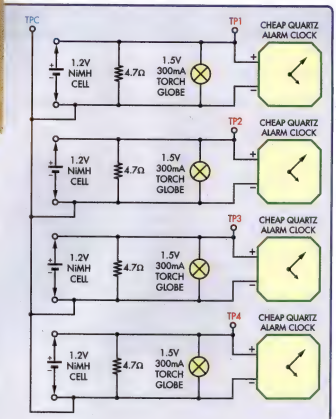
Batteries are nearly always connected in series when used in digital cameras and other equipment. One battery going flat before the others, apart from being a nuisance, can cause the flat battery to become reverse charged, damage it and further affect its capacity

Eneloop, Varta and Energizer appear to be fairly consistent in regard to the capacity of individual batteries of the same type although based on my tests, less well-known brands appear be quite inconsistent between cells in a given pack, as well as having less than their rated capacity.

For example, from a 8-pack of brand-X AA cells, marked 2700mAh, the following test results were obtained: (1) faulty; (2) 1400mAh; (3) 1580mAh; (4) 1710mAh; (5) 1550mAh; (6) 1470mAh; (7) 1710mAh; (8) 1550mAh. Another 12-pack of AA batteries, marked 2500mAh, all gave problems from day one and were disposed of.

Out of frustration, I made up a simple 4-cell battery tester, costing about $10.00. It uses four cheap quartz alarm clocks, usually available from bargain shops for around $2 each. Tests show that they stop running when the supply voltage drops to about 1V. Since it is nearly impossible to solder wires to the battery contacts in these, I made dummy batteries from pieces of dowelling and self-tapping screws.

Also required are four 1.5V 300mA MES torch globes and MES lamp holders, four 4.7Ω 0.5W resistors and a 4-cell battery holder. I recycled a faulty 4-way AA-AAA battery charger which had good quality battery contacts. This allows testing and matching of both AA and AAA cells. Ordinary M3 screws were used for test points; handy for checking battery voltages during tests. The resulting discharge current from 1.2V NiMH batteries with this set-up is close to 500mA.



Operation is extremely simple: set the clocks to 12 and insert freshly charged batteries. When the globes extinguish, read the elapsed time in hours and minutes.

You can calculate capacity in mAh by multiplying the elapsed time in hours (with minutes expressed as a decimal) by 500. While measuring the actual battery capacity in mAh is useful, accurate matching of cells to be used in series is more important. Matched sets of batteries should be marked and always used together. All matched sets should be given a capacity test every few months to ensure that they have not deteriorated and are still closely matched.

Poul Kirk, South Guildford, WA. ($40)

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Jeff Thomas is this month's winner of a Peak Atlas Test Instrument

Bathroom fan/timer has single switch operation

This bathroom/toilet fan timer was developed because of the difficulty in installing extra wiring for a separate switch to control the fan. Not only did the fan need to be switched on but it also needed to run for a time after the light switch was turned off. The solution involved a Triac controlled by an optoisolator and a 4541 oscillator/programmable timer. A 4-wire connection is used to the existing bathroom lamp which picks up the 230VAC Active lead, the Neutral, Earth and also the "switched" Active from the existing light switch.

The switched Active (SA) is used to both switch on the fan and initiate the timing function. The SA signal is coupled via two 47nF 250VAC X2 capacitors to the LED in a 4N25 optocoupler, OPTO1. The two paralleled capacitors limit the current through the LED to about 9mA. The 220kΩ resistors across the 47nF capacitors provide a discharge path when the power is turned off.

Diode D1, connected in inverse-parallel across the LED in OPTO1, is there to provide current flow during the negative half-cycles of the mains waveform while LED1 is included to give a visual cue that the circuit is working, during a bench test.

When OPTO1 is turned on by the SA signal, it turns off transistor Q1 which is normally held on by its 10kΩ and 4.7kΩ base bias resistors. Since it is effectively being switched by a 50Hz rectified signal, diode D4 and its associated 10µF capacitor is used as current pump to apply a high signal to the master reset (MR) pin of the 4541 oscillator/timer, IC1.

IC1 is configured as a retriggered "one shot" timer so that while MR (pin 6) is held high, the timer is continuously retriggered (Q held high). When pin 6 goes low, the one shot delay timer function takes over and 65,536 oscillator pulses are counted before the 'Q' output goes low again.

The resistors and capacitor connected to pins 1, 2 & 3 set the oscillator frequency so that 65,536 pulses represents a period of about 4.5 minutes. While pin 8 is high for the 4.5 minute period, it turns on transistor Q2 to drive the LED in a MOC3041 zero voltage switching optoisolator (OPTO1) and this, in turn, gates on the Triac (TRIAC1) to drive the fan.

At first switch-on, the circuit will operate as the timer will be triggered initially, however it should switch off again after the (4.5 minute) time delay. After that, the load can be switched on using a test switch for the SA input. The power to the load should be switched off about 4.5 minutes after the test switch is turned off. You will be able to observe the operation of the switch and the power to the load by watching the indicator LEDs on the board.

Any troubleshooting must be carried out with the power turned off and the circuit disconnected from the mains supply. Note that the final connection to the house wiring should be made by a licensed electrician.

Jeff Thomas,
Falls Creek, NSW.

WARNING: all parts within the red shaded area of the circuit operate at high voltage (ie, 230VAC) and contact could be fatal. DO NOT build this circuit unless you are very experienced with high-voltage circuits and construction techniques and

Your old mobile phone battery can power a LED torch

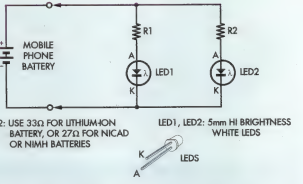
Next time you change your phone or your phone battery, save the battery and make use of it before it dies. Even if it doesn't run your phone any more it will have enough capacity to make a bright and handy torch.

Older phones used rechargeable Nicad or NiMH (usually 3.6V) batteries whereas recent ones have smaller, lighter 3.7V Li-ion units. Modern 5mm high-brightness white LEDs are economical to run and well matched to phone batteries since they have a typical forward voltage, Vf, of 3.3V @ 20mA.

Li-ion batteries charge up to about 4.1V and fall to 3.7V. Similarly, a Nicad or NiMH 2-cell battery will charge to about 3.6V and discharge to less than 2.5V in phone use.

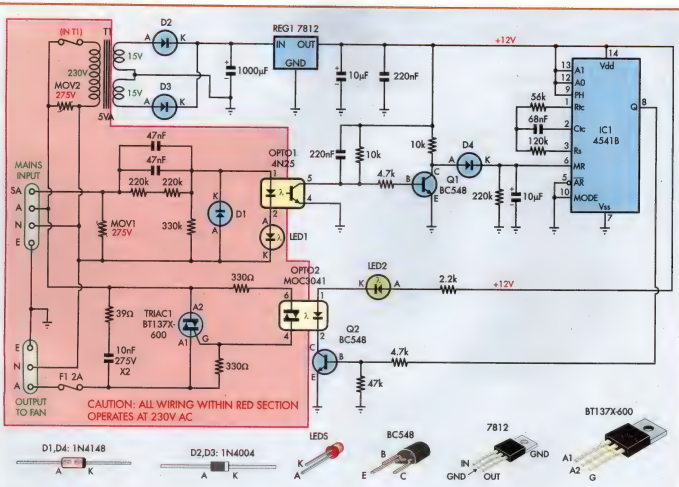
Rather than design a fancy boost regulator to cope with these voltage ranges, the simple approach is to connect the battery to the white LED via 33Ω resistor in the case of Li-ion batteries and 27Ω for Nicad and NiMH 2-cell batteries. This results in a LED current of about 12-24mA.

However there is no need to wait for the LED to become dim – just charge the battery more frequently! Two LED/resistor pairs in parallel provide a brilliant white light and



will run for tens of hours, even on a small battery.

The accompanying photo shows two torches with different battery styles and polarities. The battery terminals may to be top or end-mounted. In either case, an improvised "L" shaped plastic sled runs along the side of the battery carrying



know exactly what you are doing.

Note also that the circuit should be fully isolated inside a suitable plastic case, to prevent accidental contact with the mains. In addition, it's important that no copper tracks run through the middle of either of the two opto-isolators (ie, OPTO1 & OPTO2), as this would compromise the isolation between the high and low-voltage sections of the circuit.

a small square of perf board with it. The LEDs are soldered side by side on the board pointing forwards.

Contact with the battery terminals is made by pieces of springy brass which are soldered to the board. Even component pigtails will do as the picture shows. A rubber band holds the assembly together and provides sufficient tension so that the sled runs parallel to the side of the battery when pushed forwards or back with the thumb. Moving the sled by a millimetre is enough to turn the light off or on as its contacts mate with the battery terminals.

Bend the contact wires to tension them and turn their tips up like the runners of a sled so that they will glide across the battery surface and its terminals without snagging. For top-mounted terminals a non-conductive shim inserted between the rear of the board and the sled can help angle the board down at the front to make better contact.

To charge the battery, first remove the rubber band to separate the sled from the battery and use the original charging set-up

John Crichton,
Orange, NSW. ($35)

PICAXE digital clock and switch control

This circuit is basically a digital clock with an hours and minutes display. It has an alarm on/off function which can be set to turn a power point on and off at any preset time.

The heart of the clock is a PICAXE28X1 which is synchronised to the mains frequency by the connection of positive half-wave rectified mains pulses to pin 11 (C0). By using the mains frequency as the timebase the clock will always be correct and never need adjusting, unless there has been a power blackout.

The digital display is multiplexed, with only digit being driven at any tone time. This relies on human vision persistence to provide a continuous display of all four digits which are common-cathode 7-segment LED displays. Each digit cathode is driven from a separate output on the PICAXE

Each digit to be displayed is in BCD format from outputs 4-7 which are buffered by a ULN2803 before being fed to a 4511 BCD to 7-segment decoder/driver.

Switches S1 & S2 connect voltage dividers to the analog inputs A0 and A1 and are used in conjunction with switch S3 to set the clock time and alarm on and off times. So to set the minutes of clock time, S1 is switched to the "clock time" position and S2 is moved to the "minutes" position. At this point, only the minutes digits will be displayed and they can be advanced using the "set time" pushbutton switch, S3.

Similarly, the hours can be set by turning S2 to the "hours" position. The alarm on and off time can similarly be set by changing S1 to the appropriate position. Selecting "run" with switch S2 returns the circuit to normal clock operation.

While setting alarm or clock times, the time will be displayed in 24-hour format but when in "run" mode it will be in 12-hour format with PM being indicated by a lit decimal point on the hours digit.

When setting the alarm on/off times the program still maintains the correct time so that when returned to the "run" condition the clock will still be correct. But when adjusting the clock time itself (S1 on "clock time" and S2 on either "minutes " or "seconds") the program assumes you are setting the clock and so cannot update the old time any more.

When the "run" condition is selected, the program starts the clock with the newly entered time. A situation can arise however, where the clock is on the correct time and the user merely wishes to change the alarm on/off time.

If switch S1 has been left on "clock time" from some previous operation and switch S2 is moved away from "run" then the clock program ceases to keep the correct time and will have to be set again. The correct procedure is to set S1 first to either alarm on or off and then move S2 away from the "run" position. That way the clock will continue to keep correct time.

A better solution may be to use a set of pushbutton switches for S1 so that "clock time" is only set by a deliberate action.

Switch S4 enables or disables the alarm function. When enabled, power will be connected to the 240VAC mains-rated relay via output C4 (pin 15) and transistor Q2 when the time set for "alarm on" is reached and will be disconnected when the "alarm off" time is reached. Also, at the "alarm off" time, the buzzer will sound, as controlled by output C5 (pin 16) and transistor Q1.

Switch S5 will turn the buzzer off or alternatively, ensure the buzzer does not sound at all if it is left in the "off" position. If the alarm function is enabled, the decimal point on the minutes display is lit.

This circuit has the ability to be easily extended to control another two relay outputs, each with their own on/off times, by adding four switch positions to switch S1 and employing the unused C-port outputs on the PICAXE (C3 is already spare and C7 can be freed by driving the decimal point directly from S4). Naturally, this would require alterations to the software.

The software will be available on the Silicon Chip website.

Jack Holliday,
Nathan, Qld. ($50)

Editor's note: this circuit may seem very similar to one by the same submitted by Jack Holliday in the September 2009 issue. However, that design was for a 6-digit PICAXE timer – it was not a clock.

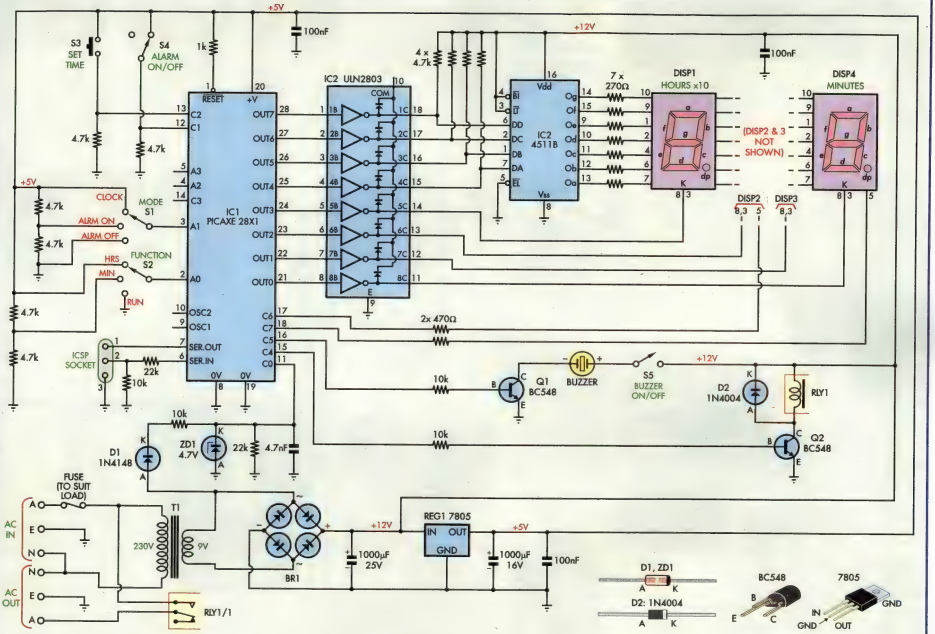
Contribute And Choose Your Prize

As you can see, we pay good money for each of the "Circuit Notebook" items published in Silicon Chip. But there are four more reasons to send in your circuit idea. Each month, the best contribution published will entitle the author to choose the prize: an LCR40 LCR meter, a DCA55 Semiconductor Component Analyser, an ESR60 Equivalent Series Resistance Analyser or an SCR100 Thyristor & Triac Analyser, with the compliments of Peak Electronic Design Ltd – see

www.peakelec.co.uk

So now you have even more reasons to send that brilliant circuit in. Send it to Silicon Chip and you could be a winner.

You can either email your idea to silchip@siliconchip.com.au or post it to PO Box 139, Collaroy, NSW 2097.



The circuit is based on a PICAXE28X1 microcontroller and is a complete digital clock with alarm on/off feature. The display is multiplexed and the timing for the clock is derived from the 50Hz mains frequency.

ALTRONICS

ONE-STOP ELECTRONICS SHOP

JANUARY 2010

Happy New Year - Welcome to 2010!

I would like to thank all of you who dealt with us in 2009. We are currently working hard on the upcoming 24th edition of the Altronics catalogue, inside which will be hundreds of new products. A few of these have even made it into this months ads. On behalf of Altronics & staff I wish everyone a happy and prosperous 2010.

Jack O'Donnell - Managing Director

Clean Power Filtering & Backup

Powershield Safeguard 750VA UPS

This quality UPS unit will prevent appliance damage caused by power fluctuations or blackouts - PLUS keep power on during a blackout! Ideal for PC's, security, phone systems & even home theatre! Also equipped with RJ45 phone line surge protection.

A small price to pay for peace of mind!

$195 D 0873 NEW!

NEW RELEASE!

ABS Plastic 19" Rack Cases

Customisable rack cases constructed from high impact ABS plastic. Internal PCB mounting posts. Generous side venting. OD: 430W x 202D x 44H (88 for 2U).

$35 H 5008 1U RRP $44.95

$46 H 5009 2U RRP $59.95

USB Datalogging SPL Audio Meter

Due Mid November

Log & graph audio levels between 30dB and 130dB on your PC. Ideal solution for venues to ensure sound levels remain legal. Great for live venues, installers, pubs etc. • Frequency range: 31.5Hz-8kHz • 30dB to 130dB • ±1.4dB accuracy. • Sampling time: Between 1s and 24hrs! • Includes diecast stand • Requires 7 x AAA batteries. Includes software & drivers for Windows XP/Vista.

NEW!

$159 Q 1263 NEW MODEL!

Protect Your Valuable Home Theatre Equipment From Surges & Spikes.

Actively reduces your power bill!

Powershield® Theatreguard Remote Control 8 Way Power, Phone & Aerial Protector. This stylish device protects equipment from spikes & surges **PLUS** it cuts power to appliances when not in use, vastly reducing your standby power usage. Unit can be operated using your existing equipment remote controls. LCD readout shows how many watts are being consumed. 8 protected mains outlets, plus aerial (PAL & F Type) & telephone (RJ11) protection. Size: 442Wx112Dx45.5Hmm.

$149 P 8140 NEW!

Soldering Station FOR LIFE

FREE! 1kg roll of solder (T 1115) & roll holder (T 2439) valued at $67.35

Insist on a professional MICRON for your next soldering iron. Featuring precision digital heating control for the best soldering experience you'll ever have! Features include: • Ceramic heating element • Zero-volt switching • Comfortable slim handle for all day use • Temperature lock • 200-490°C range • Antistatic strap point.

2 Year Warranty!

$265 T 2435 VALUE!

Stunning Quality Hi-Fi Headphones

NEW MODEL! Deep bass with crisp treble and full midtones. Supplied with 6.35mm and 3.5mm adaptor. Very comfortable!

SAVE 20%

$79 C 3014A RRP $99

Replace Up To 8 Remote Controls With ONE!

New Low Price!

Featuring multi-colour screen and stylish aluminium case. Simply learns from your existing remotes

- Multi-colour backlighting for each device
- Touch sensitive screen
- Compatible with the latest AV devices. • For night time viewing it will even light up as soon as you pick it up.
- Requires 4xAAA batteries

$129 A 0996 REDUCED

Add Sensational Sound To Your Lounge Room!

SAVE $100!

Top quality sound from a compact & stylish design. Can be inverted for mounting on the ceiling for a stylish corner hi-fi speaker. The 6.5" mid/bass driver and silk dome tweeter together produce a crisp frequency response with deep bass for realistic cinema effects. 50W RMS output. Sold in matching pair. Size: 330W x 500H x 220D.

$49 C 0290 RRP $149

Address Large Crowds With Ease.

The Redback Portable PA is ideal for clubs, gymasiums & demonstrations. Rugged, durable & lightweight! Designed to endure the punishment of every day use. Great for hire companies, schools, auctioneers etc. Employing an industrial strength extruded aluminium enclosure with hard wearing powder coat finish. It is fitted with wheels and extendible handle for ease of mobility. This allows systems to be tailored to individual needs. An in-built Class D amplifier exhibits very high efficiency for increased battery life & reduce system weight. Up to 8 hours use from a fully charged battery! In-built top hat allows easy mounting to speaker stands. **See website for more information on this versatile portable sound system.**

SAVE $690!

Rear panel & cover.

$1400 C 7176AS RRP $2090

Special Package Price!

Includes: • C 7176A Portable PA with UHF receiver & MP3 CD player. • C 7164 protective cover. • C 8872C UHF handheld OR C 8875C UHF beltpack & C 8907 lapel mic.

Package valued at $2090!

Cable Bargains!

Less than 64¢ a metre

Cat5e 305m Boxes

Top quality cat5e in a convenient and neat pullbox.

1 Box $195 ALL COLOURS RRP $274.50

W 2760 grey
W 2761 blue
W 2762 pink
W 2763 orange

Pro Shielded Audio Cable

For home or car use. With centre earth wire & soft sheath. Minimum buy 5m.

Top quality! 30% OFF.

$2.60/m W 3000 RRP $3.70/m

Split Flex Cable Loom Tubing

Great for computer & AV cabling! Protects cable looms from damage & keeps wiring tidy. 10m length. 13mm diametre.

10m for $12 H 3802 RRP $16.35

Whopper Cable

Oxygen free cable for use in home theatre & car audio. Full 50m rolls only.

SAVE 20%

$55/roll W 2140 RRP $70/roll

Coax & Fig 8 'Combo' Cable

Perfect for wiring up surveillance cameras! Features a RG59 75Ω coax and heavy duty Fig 8 in a single sheath.

SAVE 20%

1 Roll $175 W 4801 100m RRP $229/rol

Ultra-Flex Mic Cable

STOCK UP AND SAVE $50/roll. Always handy for custom audio leads. Full 100m rolls only. **W 3026 Red, W 3028 Black, W 3030 Blue.**

$95/roll RRP $145/roll

Great Test & Tool Discounts...

$149 T 2600 RRP $183

BARGAIN!

Soldering Station & Fume Extractor

Are you sick of soldering in a smoke filled workshop? Well why not whisk the fumes away with this professional quality ALL METAL fume extractor & soldering iron combination. Built tough to ensure it will last you for many years to come! • High 60W power output (250-430°C range) suits just about any job • 1.6mm tip • Iron stand & sponge included • Ceramic heater for rapid heat up and recovery.

Reduce Heatshrink in an Instant!

Pocket sized thermo-gun. Great for reducing heatshrink, removing adhesives, paint etc. With a flick of the trigger it instantly powers up to a whopping 650°C! Powered by a refillable cartridge (T 2475 $6.85).

$30 T 2480 RRP $36

$9 T 1230 RRP $10.30

Extends tip life!

Dry Soldering Tip Cleaner

Provides a quick easy way to remove excess flux and solder from your tip.

125W 'Go Anywhere' Professional Gas Tool

• Wireless operation • No need to run extension lead! to your work area • High quality construction • Easy to light one-click piezo ignition • High reliability, long life tips • A great portable soldering solution! Available as an iron only (T 2600) or a great kit including blow torch, hot knife & hot air tips, solder, sponge and hard carry case (T2601). Powers on for up to 4 hours from a full tank of gas!

$99 T 2600 Iron RRP $113.85

$125 T 2601 Kit RRP $159.95

Iroda® Gas Iron Tips

Save 30% on the full range of Iroda® tips to suit T 2595, T 2599, T 2600, T 2601, T 2630, T 2631.

$15 T 2602 T 2617 RRP $21.70ea

Test Gear Deals!

SAVE $55

$289 Q 1520 RRP $340

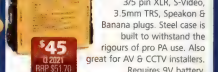
Precision Benchtop Multimeter

Ideal for the workbench or service department. Featuring a jumbo backlit display for easy reading, this precision multimeter provides true RMS measurement, datalogging, USB/serial PC interface and much more! 240V or battery powered (6 x C Cells). • 10A AC/DC • Frequency to 50MHz • Software, temp probe, PC interface leads included • Inbuilt stand • Cat IV 1000V

$45 Q 2021 RRP $51.70

Test AV Leads In Just Seconds!

Allows quick and easy confirmation of cable integrity. Compatible with 6.35mm jack, 3/5/7/8 pin DIN, RCA, 3/5 pin XLR, S-Video, 3.5mm TRS, Speakon & Banana plugs. Steel case is built to withstand the rigours of pro PA use. Also great for AV & CCTV installers. Requires 9V battery.



$299 Q 1982 RRP $344

Professional Grade Function Generator

A useful device for checking response of audio circuits etc. Operates as a standard waveform generator with sinusoidal, triangle and square wave outputs. DC offset and symmetry. Adjustable output between 0.03Hz & 3MHz. Plus a 3 MHz counter. 251Wx291Dx91Hmm.

19pc Field Technicians Tool Kit

A handy zip up pouch containing an array of handy tools including:
• Needle nose pliers • Bent needle nose pliers • Serrated plier/cutter • Side cutters • Bull nose pliers • Flat pliers • Fine tip tweezers • 3 x philips #00, #0, #1 • 3 x flat blade 2.0, 2.5, 3.0 • 6 x Star/Torx T6, 7, 8, 9, 10, 15

$39 T 2152 RRP $49

Neat Conduit Cuts In Seconds!

This ratchet conduit cutter is ideal for electrical tradespeople. Capable of cutting through conduit from 6 to 42mm in diameter.

$19 T 2662 RRP $22.95

Save up to 30%

1000V Rated Insulated Screwdrivers

With rubberised grips & chrome vanadium tips! EN 60900 Approved.
T 2194 kit includes 3 blade, 2 phillips plus 240V tester.
Individual Drivers...
T 1982 4mm blade
T 1984 6.5mm blade
T 1987 #1 phillips
T 1988 #2 phillips

$19 T 2194 6pc Kit RRP $27.95ea

$4.95 Drivers RRP $7.70ea

All In 1 Ratchet Driver Kit

12 in 1 driver set with ratchet action designed for service technicians. Ideal for communications gear, phones, laptops. Can be locked as a normal driver if required. **Kit contains:** Ratchet driver with extension bar • #000, #00, #0 phillips bits • 1.5, 2 & 2.5mm flat blade bits • T4, T6, T7, T8, T10, T15 torx bits.

$22.95 T 2108A NEW!

Cable Stripping Made Easy!

Strips wires in an instant! A real convenience compared to using cutters or even teeth (ouch!).

HOT SELLER

$15 T 1937 RRP $20.95

High Power Blow Torch

Handheld or self standing design for tasks such as heatshrinking, model making, silver soldering! Gas and air flow adjustments allow a wide range of temperatures. Easily refilled with butane gas. Robust all aluminium design.

$75 T 2494 RRP $93.85

Super hot 1350°C flame output!

Test LAN / UTP Cables FAST!

This pocket size LAN tester saves you time and frustration identifying bad network leads! It instantly displays the status of all conductors (shorted pins, straight or crossover identification). Suits common network configurations. Includes battery.

$40 T 3000 RRP $44.95

Pull Through Cable Runner

Takes the hard work out of threading cable in conduit! Simply attach the flexible spring steel hook to the cable and pull it back (through the conduit!

$35 T 4608 15m RRP $41.75

$49 T 4610 30m RRP $57.45

$90 T 4612 60m RRP $105

Punch Down Terminal Tool

An essential for anyone in IT. Connects UTP data leads into Krone® or 110 style terminal blocks. In-built wire removal tool.

Why pay up to $80?

$18 T 1603 RRP $21.80

Professional Cable Tacking Gun

Safely 'staples' cable runs to roof beams and wall cavities without damaging insulation. Staples are suitable for use in hard wood beams. Cable size 4-8mm⌀ (also suits flat cabling). Includes 50 of each staple size. T 2358 & T 2359 Pk 200 staples to suit $14.95/pk.

$39.95 T 2357 NEW!

Handy Croc Clip Leads

Pack of 10. Red, black, green, white, yellow (2 of each).

2 For $10 P 0415 RRP $6.95ea

EXPRESS ORDER HOTLINES:
Phone: 1300 797 007
Fax: 1300 789 777
www.altronics.com.au

ALTRONICS
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Security For Home or Business.

Home Video Door Intercom

See who's at the door before opening it! A safe and easy way to monitor your front door. Kit includes power supply, hookup cable, indoor base station and camera unit. Coupled with a door strike (available separately) you can even remotely unlatch your front door/gate to let visitors in. Can be expanded to 2 indoor stations and 2 cameras. Black & White only.

- Extra indoor unit **S 9414A** $137
- Extra camera **S 9415A** $79.35

$179 S 9413A RRP $206

SAVE $27

Entryway Mat Pressure Sensor

Interface this pressure mat into your alarm system or shop entry. Circuit closes when stepped on. 80x54cm.

15% OFF! $29 S 5184 RRP $34.45

Colour Reversing Camera Kit

Features a vibrant 2.5" colour LCD screen which mounts to the dashboard, providing an ultra wide angle view of the road/driveway behind.

A must have for easy parking or safe reversing, with or without a trailer. Features a weatherproof 120° camera connected via a 5m lead. Connects easily to your car's reversing lights, powering the unit up instantly when required. **Backing up the caravan has never been easier!**

$169 S 9423 RRP $194

AEI® Keycode Access Pad

Single or multi user 4 digit entry code system, perfect for access control in home or business applications. Features 3 outputs; 5A NC/NO for door strike & 2 x 1A outputs for alarm triggers. **Up to 100 million possible entry codes!**

Weatherproof design ideal for workshops & entryways.

$55 S 5372 RRP $67.95

Measure Light Levels Instantly!

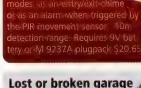
Checking light levels is an essential part of selecting the right camera for your CCTV install. Also great for lighting installs. High precision sensor provides instant, reliable Lux readings.

$45 QJ 1270 RRP $51.95

An essential tool for CCTV consultants and installers!

Mini PIR Door Minder & Alarm

Excellent unit for use in home, office, shop etc. Working 2 modes as an entry/exit chime or as an alarm when triggered by the PIR movement sensor. 50m detection range. Requires 9V battery or MJ 9232A plugpack $20.65



BARGAIN! $30 S 5209 RRP $34.45

CCTV Power Supply With 9 Outputs - $40 OFF!

A central CCTV power supply providing 9 x 11-13VDC outputs, each at 500mA. Individually fused. Simply plugs into a standard 240V GPO. Size: 165Wx200Hx54Dmm

Connect all your camera's to a single power supply!

$143 S 9753A RRP $193

4 Way AV Distributor

Split one composite/ S-Video & stereo signal into FOUR!

Ideal for business surveillance systems requiring multiple monitoring points, such as retail stores, clubs etc. Units can be daisychained for even more outputs! Includes plugpack. Size: 190Wx90Dx25Hmm.

$60 A 3120 RRP $79.95

Lost or broken garage door remote?

This Elsema remote control is used around Australia for garage doors, gates and access control systems. This replacement can be easily coded for your system in minutes! 200m range.

$50 A 1017 RRP $64.95

4 Channel Digital Video Recorder

This digital video recorder will form the hub of any surveillance system. It provides switching, quad processing and recording functions all in one. **Records directly from up to 4 cameras** (up to 25 frames per second) to an internal hard drive - available separately. • Direct connection to a PC via USB for recovery of archived recordings • Scheduled recording • Motion detection triggering • Very easy to setup • On screen menu • Includes software for Win 98/2000/XP. • 500GB hard drive to suit D 5512 $106.

Replace an old time lapse VCR or create a new high tech CCTV system!

$225 S 9344E RRP $270

Connect a CCTV System to any PC Monitor.

Beware of inferior low res products

This compact VGA converter displays a composite signal up to high resolution, 'flicker free', SXGA 1280x1024. Ideal for integrating CCTV into your AV system. BNC input, DE15 VGA output. Requires M 9274A plugpack $25.25.

$110 S 9295 RRP $137

2.4GHz Wireless AV Sender

Great for wireless CCTV applications. The easy cable-free way to transmit stereo audio & composite video up to 30m. It also relays infra-red allowing you to control equipment remotely. Includes transmitter, receiver and plugpacks.

$59 S 9390A RRP $79.95

AV to UTP Cable Transceivers

Transmit stereo audio and composite video up to 600m over Cat5 cable! Two units required to form a link. 600m (B+W) or 300m (colour). No power required.

Save a fortune in cabling costs!

2 For $70 S 9249 RRP $39.95ea

AV RF Modulator

Converts a composite video & stereo audio signal into a RF coax output. Ideal for distributing AV signals. VHF ch 0 or 1. Requires M 9271 plugpack $12.95.

$10 S 9231 RRP $14.95

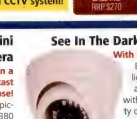
CCD Mini Camera

Housed in a tough diecast metal case! Top notch picture from a 380 line CCD sensor. Ideal for discrete indoor surveillance requirments. Includes bracket. Requires 12VDC plugpack (M 9265A $19.75).

$109 S 9650A RRP $135

See In The Dark Camera

With 14 IR LEDs! Excellent low light performance coupled with sharp clarity day time use. Sturdy housing suits sheltered outdoor installs such as under eaves, patio's etc. . CCD sensor M 9272A plugpack to suit $20.65.



$115 S 9119B RRP $159

Colour All-Weather Day/Night Camera

SAVE $36

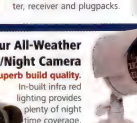
Superb build quality. In-built infra red lighting provides plenty of night time coverage. Rugged diecast enclosure can be mounted in exposed outdoor areas. Colour CCD. M 9449A plugpack to suit $24.95.

$135 S 9138 RRP $171

Super Light At Night!

Infra red illuminator

Extends your camera's night time IR range by up to 30m. Features 15 high output IR led's housed inside a waterproof aluminium case. Requires 12VDC plugpack (M 9265A $19.75).



$84.95 S 9140C NEW MODEL

BNC Video Leads

2 for $12 P 6336 RRP $9.15ea

1.5m length. Ideal as patch leads from a DVR to monitors or cameras etc. Gold plated connectors.

ALTRONICS
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No Risk 14 Day Money Back Guarantee

If you are dissatisfied with our goods for any reason, return to our premises within 14 days for a full refund (less transport costs). Returned items must be in NEW condition with all packaging and instructions.

D-I-Y Projects...

Digital-Analog Converter Kit

Audiophile quality stereo sound at a fraction of the cost!

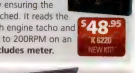
(SC Sept-Nov '09) This professional quality kit can drastically improve the sound output from your DVD player, allowing you to obtain audiophile quality sound from a regular CD/DVD player, set-top box, PVR or computer. Also reduces buzz, hum and signal noise, ensuring your listening experience is top notch. Coaxial or optical inputs. RCA output. 240V mains operation. **Includes screened and punch rack case, all components, transformer, PCB's and cabling.**

$299 K 5333 NEW KIT!

Reduce Unwanted Noise & Vibration On Boats.

Motor boat engine speed matching kit (SC Nov '09)

This module can dramatically reduce vibration & noise by ensuring the RPM of each engine is matched. It reads the frequency signals from each engine tacho and displays RPM difference up to 200RPM on an analog guage showing. **Includes meter.**



$48.95 K 6220 NEW KIT!

Zap Your Batteries Back To Life!

Lead Acid Battery Zapper & Desulphator Kit. (SC July '09)

Why buy a new battery when you might be able to rejuvenate your current one? This handy kit can help inject life into your old car or motorcycle battery. It connects in-line between the charger and the battery to help desulphate and rejuvenate cells.

$79.95 K 1687 NEW KIT!

Web Server In A Box (WIB) Kit

(SC Nov '09) Host and update your own website without the need for a computer! This compact box houses a chip based server that may be accessed anywhere in the world - even from a mobile phone. Beyond serving web pages it can also monitor and log four analog inputs, or control four digital outputs for remote activation of devices.

$89.95 K 8210 NEW KIT!

Great for remote monitoring & control

Check Battery Condition With Ease!

NEW!

(SC Aug '09) A companion battery checker for the K 1687 battery zapper. Checks the condition of 6, 12 and 24V cells . Suits lead acid and sealed lead acid batteries. Lets you know in an instant if your battery needs a zap!

$79.95 K 1688 NEW KIT!

Digital Megohm Meter Kit

(SC October '09). New updated digital version of a kit favourite!

Ideally suited for checking insulation breakdown in electrical wiring, transformers, automotive generators and alternators. 500V or 1000V range. Reads up to 999MΩ and leakage currents to below 1μA. Requires 4xAA batteries.

$79.95 K 2556 NEW KIT!

Record Sound Direct Onto SD Card!

SD Card Speech/Music Recorder Kit. (SC Aug '09) Records WAV sound files onto a SD/MMC card. May be used for sound effects, music or voice recording. Operates as a free standing unit or connected to a PC, Mac or Linux machine. Requires 12V battery pack or plugpack.

$74.95 K 556 NEW KIT!

NEW!

High Security 3 Ch. UHF Remote Control System

Rolling Code Transmitter & Receiver Kits

(SC Aug-Sep '09) Ideal keyless entry system for home or business. Control garage doors, door strikes, lighting and more. Three individual outputs. Up to 16 transmitters can be used in one system. **Kits include cases.**

$39.95 K 1157 Transmitter

$84.95 K 1958 Receiver

Programmable Thermometer & Thermostat Kit

Altronics exclusive!

Measures temperature from -55°C to +125°C and provides a set of NC or NO contacts for activating devices at preset temperature levels. Highly accurate to 0.1°C. Fully adjustable temperature limits. Ideal for monitoring air conditioners, cool rooms, cellars etc. Sensor may be located up to 300m away. Internal buzzer. 12VDC powered.

$85.95 K 6115 NEW KIT!

Keep Your Valuable Batteries In Top Condition

USB Smart Battery Charge Controller Kit (SC June '09) Perfect for battery monitoring in solar power and battery backup systems. Monitors the charge and discharge of 9-60V lead-acid, Nicad and NiMH batteries, up to 80A. Adjustable over-load & under-voltage protection, plus USB for logging battery conditions on your PC.

$175 K 1700 NEW KIT!

Altronics exclusive!

Digital Audio Oscillator Kit

(SC June '09) Provides an adjustable 10Hz to 30kHz output in sine, square, trianble and sawtooth waveforms for testing amplifiers, speakers and other audio devices. Three output ranges: 20mV, 200mV & 1V. Requires 9V battery.

$89 K 2547 NEW KIT!

Resellers

WESTERN AUSTRALIA		
Esperance	Esperance Communications	9071 3344
Geraldton	ML Communications	9965 7555
QUEENSLAND		
Brisbane South	Delsound Pty Ltd	3397 8155
Brisbane North	Prime Electronic Components	3252 7466
Capalaba	Leading Edge Electronics	3245 0000
Cloncurry	Access Electronics	4742 2590
Disby	Camera House	4662 3228
Gladstone	Leading Edge Electronics	4972 6660
Gold Coast	Prime Electronics	5531 2599
Gympie	Leading Edge Electronics	5483 6677
Hervey Bay	Leading Edge Electronics	4124 1490
Innisfail	Leading Edge Innisfail	4061 6214
Kingaroy	South Burnett Computers	4160 4800
Longreach	Access Electronics	4658 0500
Maryborough	Leading Edge Electronics	4121 4559
Mossman	Leading Edge Electronics	4098 2200
Rockhampton	Access Electronics	4922 1058
Toowoomba	Michaels Electronics	4632 9990
Townsville	Soles	4771 4211
Yeppoon	Keppel Electronics	4939 1555
VICTORIA		
Ballarat	Wiltronics	5334 2513
Ballan	Radcomp	5368 1761
Beaconsfield	Electronic Connections	9768 9420
Benalla	North East Electronics	5762 2710
Castlemaine	Top End Technology	5472 1700
Clayton	Rockby Electronics	9562 8559
Cranbourne	Bourne Superstore	5996 0755
Croydon	Truscott's Electronics	9723 3860
Geelong	Academy TV	5248 1621
Horsham	Leading Edge Electronics	5382 4182
Leongatha	Gardner Electronics	5662 2881
Leongatha	Leongatha Photographics & Elect.	5662 3227
Melton	Tandy Electronics	9743 1233
Nunawading	Semtronics	9873 3555
Pakenham	Get Smart Hi-Fi & Repairs	5941 4886
Portland	PR Electronics	5521 1121
Preston	Preston Electronics	9484 0191
Swan Hill	Lateral Communications	5032 2322
Warrnambool	Koroit Street Electronics Services	5561 5111
Wodonga	Exact Computers and Electronics	6056 5746
Wonthaggi	Ransey Pty Ltd	5672 4774
NEW SOUTH WALES		
Brookvale	Brookvale Electrical	9938 4299
Cober	Cober Electronics	6836 2962
Deniliquin	Wired Entertainment	5881 3555
Forster	Powerpoint Electronics	6554 5066
Griffith	Griffith Systems Plus	6964 5933
Gunnedah	Protronics	6742 2110
Muswellbrook	Leading Edge Electronics	6543 1904
Newcastle West	Benchmar Products	4956 7111
North Richmond	CPT - Candle Power Technology	4571 4699
Orange	Fordray Electronics	6362 9901
Parramatta	Itronics Business Solutions	9633 9200
Penrith	Penrith Light and Sound	4722 2223
Port Macquarie	John Fetell Two Way Radio	6581 1341
Raymond Terrace	Leading Edge Electronics	4987 4099
Smithfield	Chantronics	9609 7218
Tamworth	Bourke St Electronics	5766 4684
Taree	Powerpoint Electronics	6557 8000
Ulladulla	Leading Edge Electronics	4454 5588
Wagga Wagga	Wagga Car Radio & Hi-Fi	6925 6111
Waterloo	Herkes Electrical	9319 3133
Wetherill Park	Technion Electronics	9604 9710
Windang	Mad Electronics	4297 7373
Wyong	Pro Disc Entertainment	4353 1100
SOUTH AUSTRALIA		
Adelaide	Actronics	8212 8212
Brighton	Force Electronics	8377 0512
Enfield	Actronics	8349 6340
Findon	Force Electronics	8347 1188
Mt Barker	Force Electronics	8391 1133
TASMANIA		
Hobart	Active Electronics	6231 0111
Launceston	Active Electronics	6334 7333
NEW ZEALAND		
Papamoa	Global PC	3 354 3333
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Pt.2: By JOHN CLARKE

Voltage Interceptor For Cars With ECUs

Last month, we described the circuits for both the Voltage Interceptor and its companion Pushbutton Controller. This month, we give the full construction details and describe how the device is installed and used.

ALL THE PARTS for the Voltage Interceptor are mounted on a PC board coded 05112091 and measuring 105 x 87mm. This is housed in a diecast box measuring 119 x 94 x 34mm. Two cable glands at one end of the box provide access for the power supply wiring and for the input and output wiring.

Before mounting any parts, check the PC board for any defects such as shorted tracks or breaks in the copper. Check also that the corners opposite the terminal end of the PC board have been shaped to clear the internal corner sections of the box. The shape required is outlined using thin tracks on the underside of the board.

Fig.5 shows the PC board parts layout. Begin by installing the six wire links and the resistors, taking care to ensure they each go in their correct place. We used 0Ω resistors for the links in our prototype but you can use 0.7mm-diameter tinned copper wire instead. Table 2 shows the resistor colour codes but you should also use a digital multimeter to check each one before installing it, as some colours can be difficult to read.

Once the resistors are in, install the 2-way pin header for LK1, then install PC stakes at test points TP1-TP5. Follow these with the diodes, zener diodes and IC sockets, taking care to ensure that these parts are all correctly oriented. Don't install the ICs yet – that step comes later.

The capacitors are next on the list. Note that seven of these are electrolytic types and must be installed with the polarity shown. The remaining polyester types can be installed either way around.

Now for regulator REG1. As shown, this is mounted horizontally on a small heatsink, with its leads bent through 90°. To do this, first bend its two outer leads down through 90° about 8mm from its body and its centre lead down about 6mm from its body. That done, secure the regulator and its heatsink to the PC board using an M3 x 6mm screw, lock washer and nut, then solder its leads.

Note: do not solder REG1's leads before tightening its mounting screw. If you do, you could stress and crack its copper pads as the screw is tightened.

Transistors Q1-Q4 can go in next (don't get them mixed up), followed by LED1. The latter should be installed with the top of its body 10mm above the surface of the PC board. It goes in with its cathode lead (the shorter of the two) towards the top edge of the PC board (note: this lead is also adjacent to the "flat" side of the LED body).

Completing the PC board

The PC board assembly can now be completed by installing the seven trimpots (VR1-VR7), the two 2-way screw terminal blocks, the DB25 socket and the relay.

Orient the trimpots with their adjusting screws positioned as shown on Fig.5 (so that the voltages increase with clockwise rotation) and be sure to use the correct value at each location. They may be marked with a code rather than the actual value in ohms, ie, 501 for the 500Ω trimpot, 102 for the 1kΩ trimpots, 103 for the 10kΩ trimpots, 503 for the 50kΩ trimpot and 104 for the 100kΩ trimpot.

The 2-way screw terminal blocks are straightforward – just make sure their openings face outwards. Once they're in, the DB25 socket can be fitted. This must be mounted with a split washer under each mounting screw to increase its height.

The first step is to fit these mounting screws and the washers in place and secure them by winding on nuts on the underside of the PC board. That done, the DB25 socket is then fitted into place and two extra extension screws then fitted from the top to hold it in place. The socket's pins are then soldered to the PC board.

Finally, complete the board by installing the relay.

Fitting it in a case

This step is easy. First, slide the completed board assembly into the case and use it as a template to mark out its four corner mounting holes. That done, remove the board and drill these holes to 3mm. Deburr each hole using an oversize drill.

You also have to drill two holes in one end of the box to accept the two cable glands. These are positioned in line with the screw terminal blocks and drilled and reamed to 12.5mm (ie, start with small pilot holes and then carefully enlarge each hole to size using a tapered reamer).

The PC board can now be mounted in the case on M3 x 6mm tapped Nylon spacers and secured using eight M3 x 4mm screws.

Initial checks

For the time being, do not install ICs1-4 (these are installed later, after some intial checks). You should also leave the Pushbutton Controller disconnected.

It's now just a matter of following this step-by-step procedure to make the initial checks:

Step 1: rotate VR6 clockwise by 20 turns to ensure that the sensitivity is set to maximum.

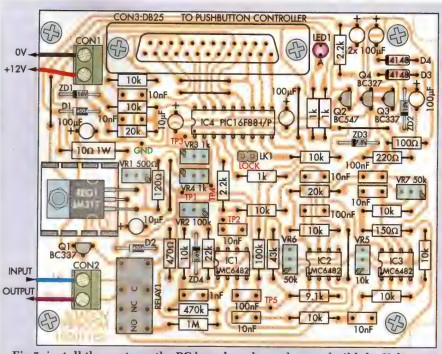
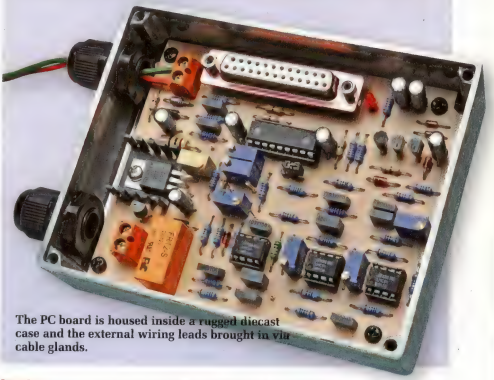


Fig.5: install the parts on the PC board as shown here to build the Voltage Interceptor unit. The assembly is straightforward but make sure that all polarised parts (semiconductors, electrolytics etc) are correctly oriented.



The PC board is housed inside a rugged diecast case and the external wiring leads brought in via cable glands.

Step 2: connect a multimeter between TP1 and the GND test point and set the meter to a low DC volts range.

Step 3: apply power and adjust VR1 for a reading of 5.0V on the meter.

Step 4: adjust VR3 for a reading of 0V at TP3, then adjust VR4 so that TP4 is at 1.1V. This will ensure that the relay will switch on with a supply as low as 11V.

Step 5: disconnect power and insert IC4 into its socket (watch the polarity).

Step 6: reapply power and check that the voltage at TP1 is still 5V.

Step 7: check that the voltage across ZD4 is 5.6V and that the voltage across

Note: zener diodes ZD2 & ZD4 were incorrectly specified in the parts list last month. ZD2 should be a 15V 1W zener diode, while ZD4 should be rated at 5.6V 1W – see Fig.5.

ZD3 is -7.5V. The voltage across ZD2 should be about 0.7V less than the supply voltage.

Step 8: if all is correct, disconnect the power and install IC s1-3 into their sockets.

Step 9: plug the Pushbutton Controller into the DB25 socket. Note that the lead used must be one that connects all pins from one end to the other in sequence, so that pin 1 connects to pin 1, pin 2 to pin 2 and so on. Some leads do not connect all pins and some swap pin connections. These leads are not suitable.

Step 10: reapply power and check that the Pushbutton Controller shows characters on the screen. Adjust trimpot VR1 on the Pushbutton Controller to set the display contrast. The initial display with the LOCK link out should show **OUTPUT 0 (dV)** on the top line and **INPUT 0 (RUN)** on the lower line. The '0' after the INPUT may be a number other than 0.

If the display shows just blocks on the top line, then there is probably a missing or shorted connection on one of the DB25 connections. Check pins 6, 8, 10, 11, 12 & 13 on the DB25 connector for continuity back to the Pushbutton Controller's LCD at pins 4, 6, 14, 13, 12 & 11 respectively. Also, check that pins 6, 8, 10, 11, 12 & 13 on the DB25 connector in the Voltage Interceptor connect to pins 17, 16, 13, 12, 11 & 10 (respectively) of IC4.

Step 11: check that the switches operate correctly. Pressing the RUN/VIEW switch should cause the display to show **VIEW** instead of **RUN** on the lower line. That done, check that the OUTPUT values can be adjusted using the UP and DOWN switches. The fast UP and DOWN switches will change the values in increments of four and the range is ±127.

Now check that the INPUT values can be adjusted using the LEFT and RIGHT switches. The range here is from 0-255.

Finally, pressing the RESET switch for 4s should reset all OUTPUT values to 0. The word **RESET** appears on the top line when this occurs.

Adjustments

Before using the Voltage Interceptor, you first need to check out the sensor it's to be used with and make some adjustments. This involves determining the voltage range that the sensor outputs under all driving conditions.

In practice, you will be able to get some idea of the maximum range available by checking the supply rail to the sensor (if it has power applied to it). For example, a MAP sensor or airflow meter that has a 5V power supply will have an output within the range of 0-5V.

Often however, the output voltage range will be restricted to a somewhat narrower range, eg, 0.5-4.5V. And a narrowband oxygen sensor will only output a maximum of about 900mV.

Connecting a multimeter to the sensor's output and measuring the voltage under driving conditions is the best way to determine its output range. The driving conditions should include full power at high and low RPM and engine overrun at high and low RPM.

Once you have the determined the voltage range from the sensor, you can proceed with the adjustments to the Voltage Interceptor, as follows:

Step 1: connect a 10kΩ linear potentiometer to the input of the Voltage Interceptor as shown in Fig.8. If the sensor provides an output that does not go above 5V, connect the top of the potentiometer to the 5V test point (TP1). Conversely, if the sensor output goes above 5V, connect the top of the potentiometer to +12V (ie, at CON1).

Step 2: apply power to the Voltage Interceptor and check that the relay switches on, as indicated by LED1.

Step 3: reset all the adjustment values by pressing the Reset switch on the Pushbutton Controller for four seconds (ie, until **RESET** is indicated on the LCD).

Step 4: adjust VR5 so that the voltage at TP5 is as close to 0V as possible.

Step 5: adjust the external pot so that the input voltage to the Voltage Interceptor (ie, the voltage on the pot's wiper) is at or just above the maximum voltage output by the sensor.

Pushbutton controller assembly

The Pushbutton Controller assembly is shown in Fig.6.

Start by installing the three wire links, including the one under the DB25 socket. That done, solder in the dual-in-line 14-pin header for the LCD module, taking care to avoid solder bridges between adjacent pins.

The SIL resistor array is next. This will have a pin 1 indication at one end (usually a dot) and this end must go towards trimpot VR1. Note that all the top seven holes must be used, leaving some free adjacent to VR1 if the array does not have 10-pins.

IC1 can now be installed, taking care to ensure it is correctly oriented. Install the two 10kΩ resistors, trimpot VR1 and switches S1-S9. Note that each of these switches must go in with its flat side to the left – see Fig.6.

We used white and black switches as indicated on the overlay. S10 is a smaller pushbutton switch that will only fit with the correct orientation.

The 10µF capacitor is next on the list. This must be mounted on its side to provide clearance when the lid is on (see photo). Take care with the polarity of this capacitor.

The DB25 right-angle socket can now go in. Make sure it is seated flat against the board and take care to avoid solder bridges between its pins.

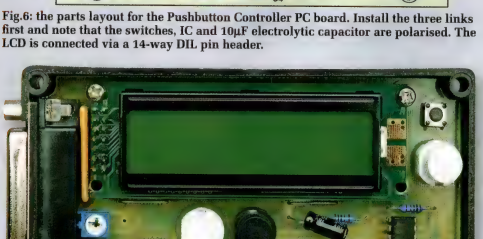
Finally, the LCD module can be installed by pushing it down onto its 14-pin DIL header. Push it all the way down until it is correctly seated against the header, then solder the header pins to the top of the module's PC board.

Fig.7 shows how the PC board is mounted in its case. If you are building

Table 1: Resistor Colour Codes: Pushbutton Controller

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	2	10kΩ	brown black orange brown	brown black black red brown

Fig.6: the parts layout for the Pushbutton Controller PC board. Install the three links first and note that the switches, IC and 10µF electrolytic capacitor are polarised. The LCD is connected via a 14-way DIL pin header.



The PC board mounts inside the case on four M3 x 12mm spacers and is secured using M3 screws, nuts and flat washers – see Fig.7. Note how the 10µF capacitor is mounted on its side, so that it clears the front panel.

a kit, the case will be supplied pre-drilled and with a screen-printed front panel. If not, then holes will need to be drilled in the base of the case for the four board mounting holes and a cut-out made to accommodate the DB25 socket in the side of the case. In addition, the lid will require holes for the switches, a cutout for the LCD and a clearance slot for the DB25 socket.

A full-size artwork for the front panel (in PDF format) can be downloaded from the SILICON CHIP website.

Note that S10's access hole in the lid should only be about 3mm in diameter, just sufficient for a small probe to actuate the switch.

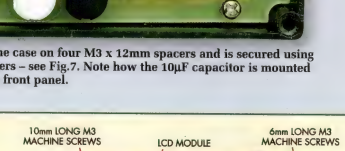


Fig.7: this cross-sectional diagram shows how the PC board for the Pushbutton Controller is mounted in the case. Note how the top edge of the LCD module is supported on two M3 flat washers.

Table 2: Resistor Colour Codes: Voltage Interceptor

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	1MΩ	brown black green brown	brown black black yellow brown
❑	1	470kΩ	yellow violet yellow brown	yellow violet black orange brown
❑	1	100kΩ	brown black yellow brown	brown black black orange brown
❑	1	43kΩ	yellow orange orange brown	yellow orange black red brown
❑	1	22kΩ	red red orange brown	red red black red brown
❑	2	20kΩ	red black orange brown	red black black red brown
❑	10	10kΩ	brown black orange brown	brown black black red brown
❑	1	9.1kΩ	white brown red brown	white brown black brown brown
❑	2	2.2kΩ	red red red brown	red red black brown brown
❑	3	1kΩ	brown black red brown	brown black black brown brown
❑	1	470Ω	yellow violet brown brown	yellow violet black black brown
❑	1	220Ω	red red brown brown	red red black black brown
❑	1	150Ω	brown green brown brown	brown green black black brown
❑	1	120Ω	brown red brown brown	brown red black black brown
❑	1	100Ω	brown black brown brown	brown black black black brown
❑	1	10Ω	brown black black gold	NA

Step 6: adjust VR2 for 5V at TP2, then adjust VR7 so that the Interceptor's output voltage is the same as its input voltage.

Step 7: adjust the external potentiometer so that the voltage at the input to the Voltage Interceptor is at or just below the minimum voltage from the sensor.

Step 8: measure the voltage at TP2, then adjust VR3 so that the voltage at TP3 is the same.

Relay switching threshold

There's a possibility that an error code will be generated by the car's ECU if the relay in the Voltage Interceptor turns on before the engine has started. An error code is usually indicated by a warning light or character on the car's instrument panel.

To prevent this error code, adjust VR4 so that the TP4 is at 1.3V. This will ensure that the relay trips only after the engine has started and when the alternator has increased the battery voltage above the 13V threshold.

Conversely, if the Voltage Interceptor does not cause an error code, then leave VR4 at its previous (lower) setting. Setting VR4 to give 1.1V at TP4 will cause the relay in the Interceptor to turn on as soon as the ignition is switched on.

Installation

Just four external connections have to be made to the Voltage Interceptor. Two of these are for power (+12V and chassis earth), while the other two connections intercept the sensor output. The sensor's output is connected to the Voltage Interceptor's input and the output from the Voltage Interceptor is then connected to the sensor's ECU wire.

Note that the original sensor-to-ECU connection has to be broken for the Voltage Interceptor to intercept the signal, ie, the Interceptor is installed in series with this lead.

Use automotive connectors for all wiring attachments and be sure to use automotive cable for the leads. The +12V rail for the unit should be derived from the switched side of the ignition and a suitable point can usually be found in the fusebox. **The connection to the switched ignition supply should be made on the battery side of the fusebox (ie, before any fuses) and should be run to the Voltage Interceptor via a 1A inline fuse.**

The best location to mount the unit is inside the cabin, so that it remains cool. If you do install it in the engine bay, be sure to keep it well away from the engine and the exhaust system so that it is not unduly affected by heat. It can be secured in position using suitable brackets.

Programming adjustments

The Pushbutton Controller must be set to RUN in order to make real time adjustments (see panel on using the Pusbutton Controller in Pt.1 last month). Before going further though, a word of warning: **the Voltage Interceptor can cause engine damage if the programming adjustments are not done carefully and methodically. You have been warned.**

The best way to tune an engine using the Voltage Interceptor is with the car set up on a dynamometer and with a specialised engine tuner making the adjustments. Alternatively, you can also make initial adjustments under actual driving conditions, using suitable instruments to monitor performance. This is best done on a closed road (eg, a racetrack). **However, do not use the Pushbutton Controller or closely monitor instruments while driving – leave those jobs to an assistant.**

Changes are made at the load sites where appropriate by using the Up and Down buttons on the Pushbutton Controller to assign values. It is not necessary to access every input load site to make changes though **but you must keep a record of any sites that are actually assigned a value of 0.** The VIEW display can then be selected later to manually adjust the output values between load sites that were not accessed during the tuning process. This is detailed later under the heading "Interpolating The Results".

Note that the input is likely to change during output adjustments. To minimise this, try to maintain constant engine conditions during programming. The unit locks onto the input value selected when an Up

Table 3: Capacitor Codes

Value	µF Value	IEC Code	EIA Code
100nF	0.1µF	100n	104
10nF	.01µF	10n	103
1nF	.001µF	1n0	102

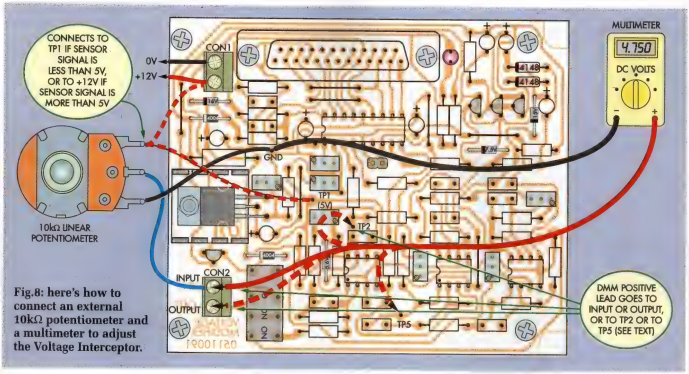


Fig.8: here's how to connect an external 10kΩ potentiometer and a multimeter to adjust the Voltage Interceptor.

or Down button is pressed so that the input load site will not alter during an adjustment, so take care to ensure that you have not drifted too far off the input load site by changing conditions.

Releasing the Up or Down button will allow the latest load site to be displayed.

Global changes

The Voltage Interceptor can easily make global changes. Global changes affect the entire load map and can reduce the number of adjustments required using the Pushbutton Controller.

A global change can be particularly useful where a sensor produces an overall lower voltage than required. For example, this could happen if a larger airflow meter is substituted for an original unit, resulting in less sensor output for a given airflow.

So for example, if you want 20% more output from a sensor, then the output from the Voltage Interceptor should always be 20% higher than its input. This can be achieved simply by adjusting VR7 to give this effect. So, if a 4V signal is applied to the Interceptor's input, then VR7 would be adjusted for a 4.8V output.

Similarly, by winding VR7 back the other way, a global change can be made to reduce the input voltage by a fixed percentage to produce a lower output.

A less likely global modification involves the offset adjustment trimpot (VR5). This can produce a global voltage offset from zero. This could be useful for narrowband oxygen sensor modifications by allowing the output to be shifted higher (for a richer reading) or lower (for a leaner reading).

Modifying sensor outputs

As previously mentioned, the Voltage Interceptor can be used to adjust the signal from virtually any sensor that produces a varying output voltage. You will need to build a Voltage Interceptor unit for each sensor output you wish to modify.

Let's take a look at some of the changes you can make:

(1) Changing The Oxygen Sensor Signal: a narrowband oxygen sensor signal can be modified but it may be difficult to make changes that have any real effect. That's because an oxygen sensor produces such a steep response in its output as the air/fuel ratio changes.

In addition, the ECU will respond to incorrect oxygen sensor signals by showing an error code. This will occur if the voltage swings from the sensor are incorrect or if the load site changes in the Interceptor are too radical. In the latter case, the injector duty cycle required to match the signal from the Interceptor may be outside the allowable range programmed into the ECU.

In addition, any changes to the sensor signal may be ineffective while the engine control is in closed loop. That's because the ECU can "learn" its way around the changes and restore mixtures to normal.

(2) Changing Air/Fuel Mixtures: in order to correctly make mixture changes, you require an accurate air/fuel ratio meter to monitor the results.

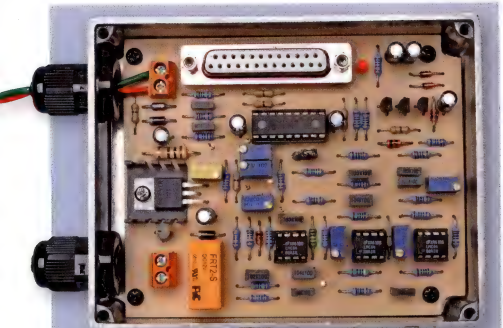
Note, however, that changes to an airflow meter signal may not affect mixture changes while the ECU is in closed loop mode. This mode occurs when the mixture is adjusted by the ECU by monitoring all relevant external sensors. If the signal from one sensor is altered by the Voltage Interceptor, this may be ignored by the ECU if it does not give results that are consistent with the other sensors.

This means that any changes made by the Voltage Interceptor to the airflow meter signal will only affect the

Changing The Sensitivity

After making adjustments, you may find that you are only using a small range of output values, eg, less than ±10. If this is the case, adjusting VR6 anticlockwise will reduce the sensitivity and allow a higher range of values to be used with improved resolution.

If you do alter VR6, then the adjustments will need to be redone. Note also that changing any of the other trimpots except VR4 will affect the entire map.



The PC board is mounted in the case on M3 x 6mm tapped Nylon spacers and the assembly secured using eight M3 x 4mm machine screws. Don't forget to install LK1 in the LOCK position when programming is complete.

mixture when the control is open loop (such as under power conditions). **Be careful when making such adjustments because engine damage can easily occur if you get it wrong.**

(3) Reducing Turbo Boost Cuts: turbo boost is monitored using either an airflow meter or a MAP sensor. You will need a boost gauge in order to correctly make this modification.

In this role, the Voltage Interceptor can be used to alter the sensor signal to prevent the ECU from reducing the boost above certain engine loads. By using the boost gauge, the load points where the boost is cut can be observed on the Pushbutton Controller and the output from the Interceptor reduced to overcome the boost cut as required.

Check that air/fuel ratios are not changed at the same time, otherwise engine damage could occur.

(4) Injector Changes: when larger than standard injectors are fitted, the airflow meter output signal can be reduced by the Voltage Interceptor to give the correct air/fuel mixtures. This will allow the ECU to operate within its normal range of input values to control the injector duty cycle.

(5) Adjusting For A Larger Airflow Meter: substituting a larger airflow meter will give lower airflow readings than from the original unit. The Voltage Interceptor can be used to restore the signal to the normal range required by the ECU for correct fuel injector control.

Interpolating the results

After making adjustments to the Voltage Interceptor, there will often be load sites that were not accessed and changed. This is because there could be up to 256 individual sites and so only a representative number of sites are adjusted.

However, it's possible to interpolate between sites. To do this, first use the View display to look for any sites that were not changed. **As previously stated, you should have kept a record of any sites that were actually mapped at 0. Any other sites with a value of 0 are unchanged (or unmapped) sites, while those sites that have a number other than 0 are obviously sites that have been adjusted.**

The job now is to make changes to the unmapped sites that sit between the adjusted sites. This involves interpolating the values so as to smooth out the changes between adjacent adjusted sites.

Interpolation involves calculating the expected values. Sometimes you can guess what the value should be but it can also be calculated. The calculation is done by first dividing the difference between two adjusted sites by one plus the number of unadjusted sites between them. This gives the difference (or step) between each site.

The example shown in Table 4 will illustrate this. Here, load sites 10, 11, 12 & 13 have values of 30, 0, 0 & 12 respectively. The difference between the two adjusted sites is 18 (30-12) and there are two unadjusted sites between them. In this case, we divide 18 by 3 (ie, 1 + 2(sites)) and this gives a difference of 6 between each site.

As a result, load sites 11 & 12 would be changed to 24 (30-6) and 18 (24-6) respectively – see Table 5.

For load sites 14-18, the output values are interpolated from an 8 at site 14 to a 0 at site 17. As indicated, site 17 is one that was mapped as a 0 and so this is kept at 0. **This means that you must keep a record of any sites which were mapped at 0 when making the original adjustments, so that they can be distinguished from unaltered load sites later on.**

Finally, when all the adjustments have been made, **the Lock jumper link (LK1) can be installed in the Voltage Interceptor to prevent any changes to the map.** You can then either leave the Pushbutton Controller connected to view the map (in either Run or View display mode) or you can disconnect it altogether. SC

Table 4: Mapped Values

Load Site	10	11	12	13	14	15	16	17	18
Initial Value	30	0	0	12	8	0	0	0*	0

0* = mapped at 0; 0 = unmapped

Table 1: initial values for load sites 1-18. The load sites with a value of 0 (ie, 11, 12, 15, 16 & 18) have been left unchanged (ie, they are unmapped).

Table 5: Final Values

Load Site	10	11	12	13	14	15	16	17	18
Final Value	30	24	18	12	8	5	2	0	0

Interpolated values shown in red.

Table 2: the load site values after interpolation. The interpolated values are in red.

WIB

Web Server In a Box

Pt.3: By MAURO GRASSI

In Pt.2 last month, we showed you how to connect the WIB to a network and gave the step-by-step setting-up details. Most constructors will settle for the website provided but for those with special needs, this third article is for advanced users who want to customise the WIB to their requirements.

ONE OF THE advantages of the WIB is that you can customise it by designing your own website if you wish. For the purposes of this article though, we'll assume that you know the basics of website design. Instead, we'll just give a few basic pointers on dynamic content and running CGI (Common Gateway Interface) commands.

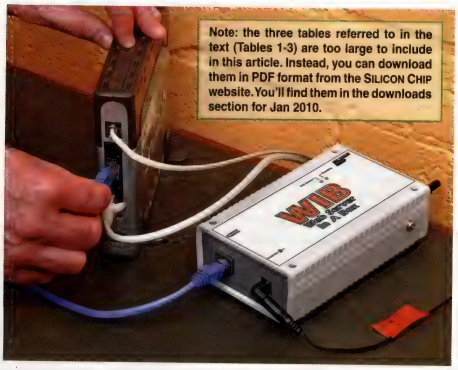
Designing your own website

Basically, it's up to you whether you use the website we have provided with the WIB or one of your own design. It's just a matter of copying the website you wish to use to the memory card.

When it comes to designing your own site, the best thing to do is to first examine the website we have provided and look at the source. We have used dynamic variables, as well as forms and Javascript.

There are plenty of HTML introductory tutorials on the web. Also you can use a freeware HTML WYSIWYG (What You See Is What You Get) editor such as ***Kompozer*** which you can download from **http://kompozer.net**

We used ***Kompozer*** to design the website provided with the WIB and you can change all its important settings if necessary.



Note: the three tables referred to in the text (Tables 1-3) are too large to include in this article. Instead, you can download them in PDF format from the SILICON CHIP website. You'll find them in the downloads section for Jan 2010.

Dynamic content

The WIB implements a simple system for dynamic content.

For dynamic pages, a string of the form ~XX, where XX represents a hexadecimal code between 00 and FF, is replaced by the value of that variable. Table 2 on the SILICON CHIP website gives a list of the hexadecimal codes and their corresponding variables.

Note that the files which are emailed are also considered dynamic content. For example, let's say that we have

An Example FTP Session . . .

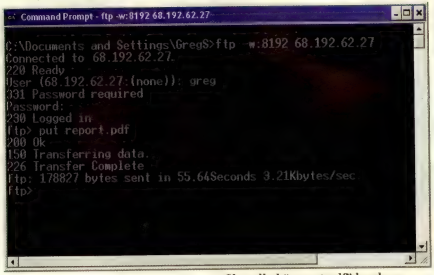


Fig.27: an example FTP session. Here a file called "report.pdf" has been been uploaded to the WIB (via the Internet) using the "put" command.

List Of Accepted FTP Commands

CD: change directory.
PWD: show the current directory.
DELETE: delete a file.
DIR: show the files in the current directory and the file sizes.
LS: show only the name of the files in the current directory.
PUT: send a file to the ethernet web server.
GET: retrieve a file from the WIB.
MGET: retrieve a collection of files from the WIB.
MPUT: send a collection of files to the ethernet web server.
USER: specify the username for login.
PASS: specify the password for login.
OPEN: open an FTP connection to a remote server.
QUIT: exit the current FTP session.

Fig.27 shows an example FTP session. Here the put command is being used to upload a file called report.pdf to the memory card in the WIB via the local network.

The first step is to connect to the FTP server and that's done by going to a command prompt and typing:

ftp 192.160.0.34

The WIB's local IP address has been used here but you would have to substitute the public IP address (or the hostname if you have set up dynamic DNS) if you want to access the WIB via the Internet (as shown in Fig.27).

After that, it's simply a matter of entering the username and password to log on and then issuing the command:

put report.pdf

The file should then upload to the WIB. If you get an error that says **"Netout: connection reset by peers"**, it means that the buffer in the Windows FTP client has overflowed and will have to be increased in size. To do that, quit the current FTP session (using the quit command), then restart it with the command:

ftp -w:8192 192.168.0.34

and try uploading the file again. This will double the buffer size from the default. If you get the same error message, double it again by starting the FTP session using the command:

ftp -w:16384 192.168.0.34

Similarly, if you want to download a file called report.pdf, use the command:

get report.pdf

a dynamically typed file containing the text:

The ~1E is currently ~D0 degrees.

From this, it follows that if the name of Variable 0 is set to "Temperature" and the current value for the temperature (derived from a temperature sensor connected to the first ADC input) is 26.5, then this would appear as:

The Temperature is currently 26.5 degrees.

As mentioned, any files sent by email, such as ***var0max.txt*** (on a maximum condition in variable #0), can also contain dynamic content. In order to show the ~ character you need to escape it by using the sequence ~~.

For example ~~02 will translate to ~02 yet ~02 will translate to the Subnet Mask (refer to Table 2).

The default ***var0max.txt*** file contains the following text:

The ~1E is currently at ~D0, which is above the set maximum of ~1C! This is an automatically generated message, created on ~E2.

As before, **~1E** will be replaced by the name of Variable 0, while **~D0** will be replaced by the current value of that variable. **~1C** is replaced by the maximum set value, while **~E2** is the current time as determined by the SNTP module. In other words, the email would look like this example:

The Temperature is currently at 30.0, which is above the set maximum of 28.0!
This is an automatically generated message, created on Fri 28 August 2009 17:00:00.

Therefore, by modifying this file and others like it, you can customise the emails that are sent as notifications.

Running CGI commands from an HTML form

It is possible to execute one of the commands in Table 1 from an HTML form. The commands are of the form:

<command>?<name>=<value>

Any system setting can then be defined using an HTML form by using the **set** command (see Table 1 on the SILICON CHIP website), the name of the variable (Table 2) and the new value, eg:

set?NTPTimezone=0

will modify the time zone for SNTP to UTC time.

An in-depth discussion of HTML forms is beyond the scope of this article but if you are interested you should look at the source code for the supplied website. A number of HTML forms are used to change the WIB's settings. By imitating these, you can create complex websites.

Memory Card Special System Files

The are several special system files on the memory card and these either have a "txt" extension or a "dat" extension. For security reasons, these two file extensions should always be set to private in the HTTP Settings (file permissions) – see text. This is the default but you can change this and open up your system to the public if that's what you really want to do (not recommended!).

You can also modify some of the special system files to customise the behaviour of the WIB. The relevant files are as follows:

log.txt: this file contains a human-readable log of system events since the last reset. It is emailed to the user each time there is a system reset. All important system events are logged, like an incoming FTP connection, a change in the public IP address detected by the dynamic DNS client, and any email sending activities.

settings.txt: this file contains a human-readable list of single line entries that override the system defaults. The user may modify this file to define new default values.

values.dat: this file is used to store system settings in binary form and should not be modified.

test.txt: this file contains the body of the test email sent when the user presses the 'Test Email' button in the supplied website. It is used to test that the SMTP settings are correct.

var0max.txt: this is the file that is emailed when variable #0 has exceeded its set maximum.

var0min.txt: this is the file that is emailed when variable #0 is below the set minimum.

var1max.txt, var1min.txt, var2max.txt, var2min.txt, var3max.txt, var3min.txt: similar to above but for variables #1, #2 and #3.

var0log.txt: this is the file that holds the logged values of variable #0. This file is emailed if periodic logging is enabled for that variable.

var1log.txt, var2log.txt, var3log.txt: similar to above but for variables #1, #2 and #3.

The settings.txt file

The default settings can be overridden by a file named **settings.txt**. This file is stored in the root folder of the memory card.

In operation, the firmware loads and parses this file at boot-up (or when there is a Master Reset). Each line should contain a statement of the form:

<setting name> = <value>

where **<setting name>** is one of the settings in Table 2 (provided it's not read only), and **<value>** is the value to set.

For example, to change the (default) gateway to 192.168.0.33 you would have a line in **settings.txt** that reads:

Gateway = 192.168.0.33

This would override the default value but not the value that was last set through the web interface. Those values are instead stored in a file called **values.dat** but in binary form.

Note that it is permissible to add any number of spaces before the equals sign for readability. For example, although the IP address settings name is **IPAddress**, you can validly set the IP Address by writing a line in your **settings.txt** file that looks like this:

IP Address = 192.168.0.30

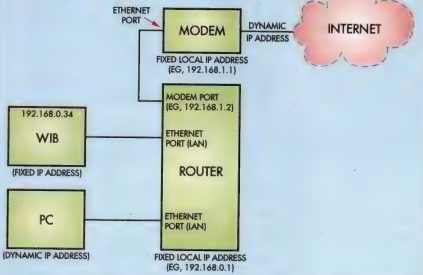
Restoring the defaults

To restore the default values, you can simply delete the file ***values.dat*** and reset the WIB by clicking the ***Master Reset*** button (or reboot the WIB). Alternatively, you can go to the Basic Settings page of the supplied website and click the ***Restore Defaults*** button.

Another option if you are creating your own website is to run the ***defaults*** command from an HTML file (see Table 1).

You can also define the current settings as the defaults by clicking on the ***Create Defaults*** button and then resetting the WIB by clicking the ***Master Reset*** button (in the supplied default website) or by rebooting the WIB (power off and on). **SC**

Correction To Fig.9(b) of WIB Pt.2



There is an error in the IP addressing shown on Fig.9(b), page 84 of the December 2009 issue. The addressing shown will not work because a router will only forward packets between different networks, eg, from 192.168.0.x to 192.168.1.x on a class C network (and vice versa).

This means that we must use IPs for two different networks on either side of the router, eg, use 192.168.1.1 for the Ethernet port on the modem, 192.168.1.2 on the modem port on the router and leave the LAN side of the router at 192.168.0.1 – see above. See also Notes & Errata, p96.

Vintage Radio

By RODNEY CHAMPNESS, VK3UG

The impressive STC Capehart A8551 Radiogram

Radiograms first came into being in the late 1920s and were produced in various formats up into the 1960s. During that time, they evolved from very basic units with a record playing mechanism on the top of the cabinet to units that had changers alongside the radio section. Some of the very latest units also included a TV set and/or a tape recorder and some even had a cocktail cabinet.

THE 5-BAND A8551 was probably the most up-market monophonic radiogram produced by STC. It dates from the mid 1950s and as can be seen from the photos, it is quite a big unit.

In terms of construction, it is basically a large rectangular box with ball & claw feet on it. It is a beautiful piece of furniture and the owner of this magnificent deluxe radiogram, Peter Henstridge (see last month's Vintage Radio), is to be congratulated for the quality of the cabinet restoration.

A feature of the cabinet is that the doors can fold right back alongside the end panels, so that they are out of the way when the radiogram is in use. When closed, the speaker grill is still visible so that the set can continue operating without the sound being muffled.

The size of the cabinet and the thickness of the timber mean that two strong people are required to move the unit around. The 12-inch (305mm) twin-cone speaker is housed in a sealed enclosure and this, along with the heavy timber construction, has been designed to ensure good sound quality. A plywood panel covers the back of the unit and the cables between the record changer and radio chassis run along a shelf at the back – see photo.

A Collaro 3-speed record changer is mounted at the top lefthand end of the cabinet. This unit comes in cream and maroon, which matches the finish of the cabinet. The radio receiver and its associated control panel are to the right, along with the switches for the various functions. Below the record changer and radio are two compartments for storing records.

The receiver itself is much more elaborate than used in run-of-the-mill radiograms. It tunes both the broadcast band and a shortwave band from 4.8-15.6MHz. It also has three bandspread international shortwave bands, these being the 31, 25 & 19 metre bands.

Six controls are located on the front of the receiver, on either side of the dial scale. Starting from top left, there are Treble, Bass and Volume controls, while the controls from top right are Tuning, Wave Band (five positions) and Selector (three positions).

Circuit details

From the foregoing, it's apparent that this is an upmarket unit and is somewhat better than the average radiogram of the era. That not only applies to the cabinet but to the circuit used as well.

Fig.1 shows the circuit details. The received signal is applied in parallel to both the broadcast and the shortwave tuned circuit primary windings. However, the secondaries are each individually switched.

The bandspread shortwave bands are selected via series and parallel capacitors which are used in conjunction with the general coverage shortwave coil and tuning capacitor. The general shortwave tuning range is different to most dual-wave receivers, though. It tunes from 4.8-15.6MHz whereas most other dual-wave sets tuned from 6-18MHz.

The output of the selected tuned circuit is applied to valve V1, a 6BA6 RF (radio frequency) amplifier. Its output is applied to another tuned circuit assembly (similar to the input tuned circuits) and then to V2, a 12AH8 frequency converter.

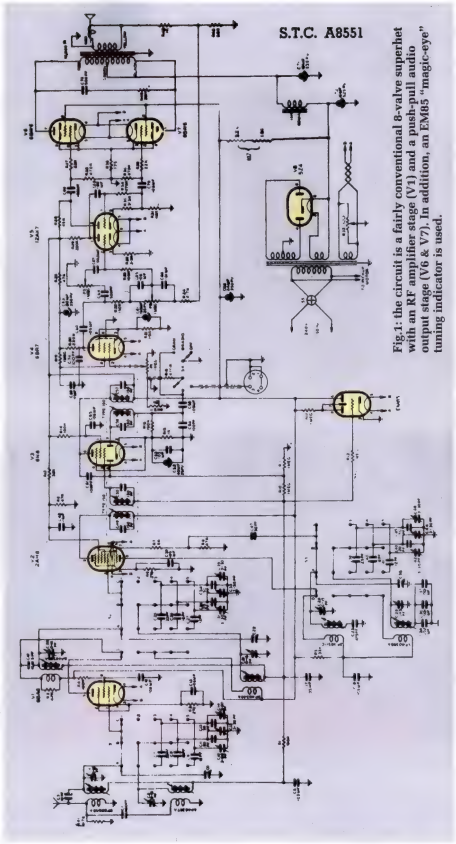


Fig.1: the circuit is a fairly conventional 8-valve superhet with an RF amplifier stage (V1) and a push-pull audio output stage (V6 & V7). In addition, an EM85 "magic-eye" tuning indicator is used.

Oscillator section

The oscillator section of the converter employs yet another tuned circuit arrangement. This ensures that the oscillator always runs 455kHz higher than the incoming RF. Many readers will not be familiar with the 12AH8. It is similar in characteristics to the more common 6AN7A but has a tapped 12V heater, so it can have either 6V or 12V applied to it.

One point that STC makes is that the padder capacitors on shortwave are selected to make sure there is minimal frequency drift as the receiver warms up. Tuning drift during warm-up up is a very annoying problem with

This view shows the A8551's cabinet during restoration. The timber was in good condition but the finish had deteriorated quite markedly over the years.

The record changer, chassis and loudspeaker were all removed from the cabinet to make the restoration easier.

some receivers. My Kriesler 11-99, for example, is a delightful little receiver but it has this problem of drifting off station from cold.

I'll eventually get round to modifying it to overcome this problem but in the meantime, I'll live with it.

The output of the frequency converter consists of several mixing products but the one of interest is the difference between the signal frequency and the oscillator frequency, ie, 455kHz. This is applied via the first IF (intermediate frequency) transformer to the grid of V3, a 6N8 which amplifies the 455kHz IF signal. Its output then goes through another IF transformer stage and is then fed to a detector diode in the 6N8.

From there, the resulting audio signal is fed through a switch (Off-Radio-Gram) and a volume control to valve V4, a 6BR7 low-noise pentode audio amplifier. The amplified audio is then applied to separate bass and treble controls before being fed to the first section of V5, a 12AX7.

The second section of the 12AX7 is wired as a phase splitter and this produces two signals which are 180° out of phase. These signals drive a push-pull amplifier stage based on V6 and V7, both 6BW6 valves. This then drives a centre-tapped audio output transformer which in turn drives the 12-inch twin-cone speaker.

Note that negative feedback is used to minimise distortion in the audio amplifier. This is done by feeding a sample of the output signal (ie, as applied to the speaker) back to one side of the tone control network.

Power supply

As with the RF and audio circuitry, the power supply is a little more elaborate than seen in most domestic radios.

First, there are four windings on the transformer: a 230-250V primary and three secondaries. These secondaries provide 6.3V for the heaters of all the amplifying valves, 5V for the filament of the 5Z4 rectifier and a centre-tapped high-tension (HT) output rated at 295V-0V-295V.

The resulting DC HT line is filtered using a choke and two electrolytic capacitors and this then feeds the plates of the two 6BW6 audio output valves via the centre tap on the primary of the output transformer. The HT for the rest of the set is filtered using a resistor/capacitor network, along with other decoupling networks for the low-level audio sections.

Because this set has a better than average audio amplifier, a "hum-dinger" pot (R3) has been connected across the 6.3V heater winding, with the moving arm going to earth. This is adjusted to minimise any hum in the output. This is R33 at the bottom right of the circuit diagram.

Automatic gain control

Automatic gain control (AGC) or as it used to be called, automatic volume control (AVC) is also fitted to this receiver. As shown in Fig.1, a small mica capacitor is connected between the plate of V3 (6N8) and one of its diodes. Normally, the 6N8's cathode is around 2.5V positive with respect to the chassis and the so diode is biased

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off via R11, its DC return to chassis.

However, if the RF signal exceeds 2.5V peak, a negative voltage will be produced at the diode's output. This is then applied along the AGC line to valves V1, V2 & V3.

This is a delayed AGC system, as the RF signal has to reach quite a reasonable level for AGC to occur. This is done to ensure good signal-to-noise ratios on weak signals.

Magic eye

Another feature of the circuit is the inclusion of an EM85 "magic eye" indicator to assist tuning. STC didn't claim this as a valve, although many other manufacturers did in their receivers.

Basically, it looks like an unusual 9-pin miniature valve. In this set, it is located just behind a small window in the back plate of the tuning dial, towards the righthand end. It produces a green "glow" that changes in shape according to the strength of incoming signals and this helps the user accurately tune stations.

When the record changer is to be used, the selector switches power to it and a light is turned on to illuminate the changer's enclosure. In addition, when the receiver is turned on, a red pilot lamp is illuminated in the middle of the cabinet (towards the bottom), so even if the doors are closed the user can see that the set is turned on.

The restoration

The cabinet finish wasn't exactly in good condition when Peter obtained the old STC. As indicated earlier, veneered solid timber is used in its construction, so there were no shortcuts to be taken here.

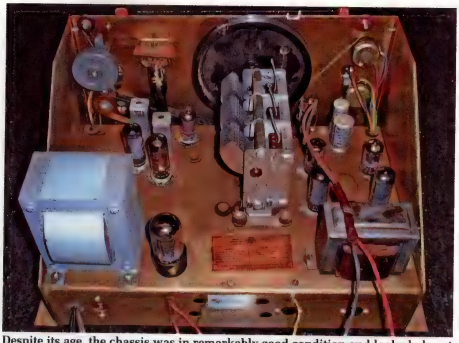
First, the chassis and other internals of the unit were removed and set aside, as were the doors, hinges and handles. Peter then set about stripping the finish off the timber with Accent Paint Stripper. This stripper is relatively mild and doesn't stain the timber like some other paint strippers do. The cabinet was then lightly sanded with a fine grade of abrasive paper.

The timber itself was in good condition and didn't require any filling. Peter points out that in order to ensure that there is no damage to the veneer, a good-quality paint stripper tool must be used along with the paint stripper liquid.

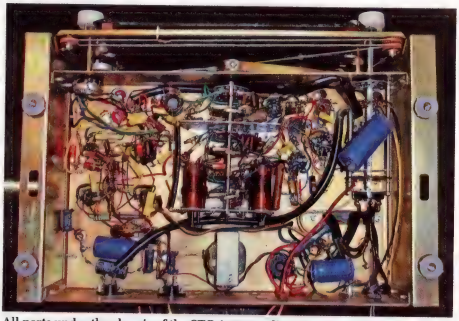
The next step was to mix a home-brew stain to match the radiogram's original maple colour. Peter used a spirit-based Wattyl product, which is unfortunately now unavailable. This was mixed with an orange base stain and a little bit of black tint. However, some areas of the cabinet required a deeper tint than others, as these areas were almost white in colour after the paint stripper had done its job.

Several layers of Wattyl Stylewood 50/50 grade clear lacquer were then applied with a spray gun. And although not strictly necessary, the cabinet was sanded using 0000-grade steel wool between some layers. This ensured a really smooth finish and gave a really professional result.

Peter makes the point that the lacquer should only be applied on warm days with low humidity or the results will be disappointing. He makes his own cabinet polish and this was then applied, after which the cabinet was



Despite its age, the chassis was in remarkably good condition and looked almost new after it was cleaned up. It's a well-made unit and the top layout is clean and uncluttered.



All parts under the chassis of the STC A8551 radiogram are readily accessible despite the circuit complexity. Replacing the dial cord, the paper & electrolytic capacitors and two resistors restored the unit to full working operation.

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This view shows the fully-restored unit with the doors open and swung fully back along the sides of the cabinet. Note the two record storage areas.

When the doors are closed, the speaker grill is still visible so that the set can continue operating without the sound being muffled. The cabinet finish is excellent and the old STC now looks like new.

rubbed down with some good quality Orange Oil. This removed any excess polish and gave the cabinet an excellent finish.

Next, the handles and hinges were all cleaned and polished. These were then given a coating of clear lacquer to keep them looking clean and reattached to the cabinet.

Overhauling the changer

Having completed the cabinet restoration, Peter's next task was to overhaul the record changer. Because of its age, the oil that's normally used to lubricate the moving parts had long since dried out and any grease that remained had congealed into a sticky mess. As a result, the mechanism was well and truly seized up.

The old grease was removed using kerosene, after which lanoline spray was used to lubricate the bearings and other parts. Some light machine oil was then applied to any bearings and shafts. In addition, oil was applied to the felt wick around the phosphor-bronze motor bearings and this now runs smoothly again and will last for many years.

Fortunately, the plater was in good condition and there were no flat spots on the rubber idler pulley. The latter was cleaned with methylated spirits on a clean cloth and the whole assembly given a light coat of lanoline to keep everything operating smoothly.

Finally, the pick-up cartridge and styli were replaced. The mechanism was then tested and it all worked perfectly.

Chassis restoration

It was now time to tackle the radiogram chassis. As previously stated, the receiver is quite a complex unit, with a total of nine valves. However, the chassis is quite large and is well laid out, with all parts easy to access (see photo). Even the wave-change switch and the components around it are relatively easy to get at.

The paper and electrolytic capacitors were all replaced so that no unexpected problems would arise in the future. The resistors were largely within tolerance and only one or two needed replacement. The dial cord also needed replacement as it had broken but the valves were all in working order.

Once this work had been done, the set was tested and it worked normally. It's sensitivity was excellent and the quality of the audio was very good, so no work was required on aligning the RF and IF stages.

In short, STC had really got it right and the amount of work required to get the chassis working again was quite minimal.

Summary

The quality of radiograms at the end of the mono era was quite variable. Some were just ordinary broadcast mantel receivers fitted into a larger cabinet with a bigger speaker. Although they did sound a little better

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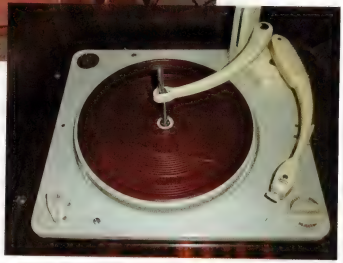
A rear view of the cabinet with the record changer and radiogram chassis mounted in position. The connecting cables between them run along a shelf at the back of the unit. This unit is much more elaborate that the average radiogram of the mid-1950s era.



The Collaro 3-speed automatic record changer required a good clean-up plus some fresh lubrication to make it run smoothly again. The pick-up cartridge and styli were also replaced.

than the mantel set versions, they tended to be "bassy" in their response and could easily be driven into noticeable distortion if the volume control was wound up.

However, there were a few radiograms like the STC Capehart where the chassis and the components were designed to give good-quality reproduction. This set uses negative feedback in the audio stage together with a pair of push-pull output valves and features a twin-cone 12-inch (30cm) speaker in a sealed enclosure, so STC was evidently serious about the audio quality.

In addition, the RF (radio frequency) section of the set is quite sensitive and a nice touch is the compensation used in the oscillator tuned circuit to prevent drift on the shortwave bands as the set warms up.

The only criticisms of this set are that it would have been quite expensive and it is big. However, it really is a beautiful piece of furniture and I would certainly like one in my collection if I had the room.

Acknowledgement: photographs by Peter Henstridge.

SC

Silicon Chip Back Issues

January 1994: 3A 40V Variable Power Supply; Solar Panel Switching Regulator; Printer Status Indicator; Mini Drill Speed Controller; Stepper Motor Controller; Active Filter Design; Engine Management, Pt.4.

February 1994:90-Second Message Recorder; 12-240VAC 200W Inverter; 0.5W Audio Amplifier; 3A 40V Adjustable Power Supply; Engine Management, Pt.5; Airbags In Cars – How They Work.

March 1994: Intelligent IR Remote Controller: 50W (LM3876) Audio Amplifier Module; Level Crossing Detector For Model Railways; Voice Activated Switch For FM Microphones; Engine Management, Pt.6.

April 1994: Sound & Lights For Model Railway Level Crossings; Dual Supply Voltage Regulator; Universal Stereo Preamplifier; Digital Water Tank Gauge; Engine Management, Pt.7.

May 1994: Fast Charger For Nicad Batteries; Induction Balance Metal Locator; Multi-Channel Infrared Remote Control; Dual Electronic Dice; Simple Servo Driver Circuits; Engine Management, Pt.8.

June 1994: A Coolant Level Alarm For Your Car: 60-Metre AM/CW Transmitter For Amateurs; Converting Phono Inputs To Line Inputs; PC-Based Nicad Battery Monitor; Engine Management, Pt.9.

July 1994: Build A 4-Bay Bow-Tie UHF TV Antenna; PreChamp 2-Transistor Preamplifier; Steam Train Whistle & Diesel Horn Simulator; 6V SLA Battery Charger; Electronic Engine Management, Pt.10.

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September 1994: Automatic Discharger For Nicad Batteries; MiniVox Voice Operated Relay; AM Radio For Weather Beasts; Dual Diversity Tuner For FM Mics, Pt.2; Electronic Engine Management, Pt.12.

October 1994: How Dolby Surround Sound Works; Dual Rail Variable Power Supply; Talking Headlight Reminder; Electronic Ballast For Fluorescent Lights; Electronic Engine Management, Pt.13.

November 1994: Dry Cell Battery Rejuvenator; Novel Alphanumeric Clock; 80-M DSB Amateur Transmitter; 2-Cell Nicad Discharger.

December 1994: Car Burglar Alarm; Three-Spot Low Distortion Sinewave Oscillator; Clifford – A Pesky Electronic Cricket; Remote Control System for Models, Pt.1; Index to Vol.7.

January 1995: Sun Tracker For Solar Panels; Battery Saver For Torches; Dual Channel UHF Remote Control; Stereo Microphone Preamplifier.

February 1995: 2 x 50W Stereo Amplifier Module: Digital Effects Unit For Musicians; 6-Channel LCD Thermometer; Wide Range Electrostatic Loudspeakers, Pt.1; Remote Control System For Models, Pt.2.

March 1995: 2 x 50W Stereo Amplifier, Pt.1; Subcarrier Decoder For FM Receivers; Wide Range Electrostatic Loudspeakers, Pt.2; IR Illuminator For CCD Cameras; Remote Control System For Models, Pt.3.

April 1995: FM Radio Tuner, Pt.1; Balanced Mic Preamp & Line Filter; 50W/Channel Stereo Amplifier, Pt.2; Wide Range Electrostatic Loudspeakers, Pt.3; 6-Channel Decoder For Radio Remotes.

May 1995: Guitar Headphone Amplifier; FM Radio Trainer, Pt.2; Transistor/Mosfet Tester For OMMs; A 16-Channel Decoder For Radio Remote Control; Introduction To Satellite TV.

June 1995: Build A Satellite TV Receiver; Train Detector For Model Railways; VHF Aircraft Radio Trainer; Low-Cost Video Security System; Multi-Channel Radio Control Transmitter For Models, Pt.1.

July 1995: Electric Fence Controller; How To Run Two Trains On A Single Track (Incl. Lights & Sound); Setting Up A Satellite TV Ground Station; Build A Reliable Door Minder.

August 1995: Fuel Injector Monitor For Cars; Build A Gain-Controlled Microphone Preamplifier; Identifying IDE Hard Disk Drive Parameters.

September 1995: Railpower Mk.2 Walkaround Throttle For Model Railways, Pt.1; Keypad Combination Lock; Build A Jacob's Ladder Display.

October 1995: 3-Way Loudspeaker System; Railpower Mk.2 Walkaround Throttle For Model Railways, Pt.2; Build A Nicad Fast Charger.

November 1995: Mixture Display For Fuel Injected Cars; CB Transverter For The 80M Amateur Band, Pt.1; PIR Movement Detector.

May 1996: High Voltage Insulation Tester; Knightrider LED Chaser; Simple Intercom Uses Optical Cable; Cathode Ray Oscilloscopes, Pt.3.

June 1996: Stereo Simulator; Build A Rope Light Chaser; Low Ohms Tester For Your DMM; Automatic 10A Battery Charger.

July 1996: VGA Digital Oscilloscope, Pt.1; Remote Control Extender For VCRs; 2A SLA Battery Charger; 3-Band Parametric Equaliser.

August 1996: Introduction to IGBTs; Electronic Starter For Fluorescent Lamps; VGA Oscilloscope, Pt.2; 350W Amplifier Module; Masthead Amplifier For TV & FM; Cathode Ray Oscilloscopes, Pt.4.

September 1996: VGA Oscilloscope, Pt.3; IR Stereo Headphone Link, Pt.1; HF Antenna Radio Receiver; Cathode Ray Oscilloscopes, Pt.5.

October 1996: Send Video Signals Over Twisted Pair Cable; 600W DC-DC Converter For Car Hifi Systems, Pt.1; IR Stereo Headphone Link, Pt.2; Multi-Channel Radio Control Transmitter, Pt.8.

November 1996: 8-Channel Stereo Mixer, Pt.1; Low-Cost Fluorescent Light Inverter; Repairing Domestic Light Dimmers..

December 1996: Active Filter For CW Reception; Fast Clock For Railway Modellers; Laser Pistol & Electronic Target; Build A Sound Level Meter; 8-Channel Stereo Mixer, Pt.2; Index To Vol.9.

January 1997: Control Panel For Multiple Smoke Alarms, Pt.1; Build A Pink Noise Source; Computer Controlled Dual Power Supply, Pt.1; Digi-Temp Thermometer (Monitors Eight Temperatures).

February 1997: PC-Controlled Moving Message Display; Computer Controlled Dual Power Supply, Pt.2; Alert-A-Phone Loud Sounding Telephone Alarm; Control Panel For Multiple Smoke Alarms, Pt.2.

March 1997: 175W PA Amplifier; Signalling & Lighting For Model Railways; Jumbo LED Clock; Cathode Ray Oscilloscopes, Pt.7.

April 1997: Simple Timer With No ICs; Digital Voltmeter For Cars; Loudspeaker Protector For Stereo Amplifiers; Model Train Controller; A Look At Signal Tracing; Pt.1: Cathode Ray Oscilloscopes, Pt.8.

May 1997: Neon Tube Modulator For Light Systems; Traffic Lights For A Model Intersection; The Spacewriter – It Writes Messages in Thin Air; A Look At Signal Tracing; Pt.2: Cathode Ray Oscilloscopes, Pt.9.

June 1997: PC-Controlled Thermometer/Thermostat; TV Pattern Generator, Pt.1; Audio/RF Signal Tracer; High-Current Speed Controller For 12V/24V DC Motors; Model Train Circuit For Stepper Motors.

July 1997: Infrared Remote Volume Control; A Flexible Interface Card For PCs; Points Controller For Model Railways; Colour TV Pattern Generator, Pt.2; An In-Line Mixer For Radio Control Receivers.

October 1997: 5-Digit Tachometer; Central Locking For Your Car; PC-Controlled Stepper Motor Controller; 1500W Audio Power Amplifier, Pt.2.

November 1997: Heavy Duty 10A 240VAC Motor Speed Controller; Easy-To-Use Cable & Wiring Tester; Build A Musical Doorbell; Replacing Foam Speaker Surrounds; Understanding Electric Lighting Pt.1.

December 1997: Speed Alarm For Cars; 2-Axis Robot With Gripper; Stepper Motor Interface & Software; Computer Power Supply For Stepper Motor Cards; Understanding Electric Lighting Pt.2; Index To Vol.10.

January 1998: 4-Channel 12VDC or 12VAC Lightshow, Pt.1; Command Control For Model Railways, Pt.1: Pan Controller For CCD Cameras.

February 1998: Telephone Exchange Simulator For Testing; Command Control For Model Railways, Pt.2; 4-Channel Lightshow, Pt.2.

April 1998: Automatic Garage Door Opener, Pt.1; 40V 8A Adjustable Power Supply; Build A Frequency Counter; 0-30kHz Sinewave Generator; Understanding Electric Lighting, Pt.3.

May 1998: 3-LED Logic Probe; Garage Door Opener. Pt.2; Command Control System, Pt.4; 40V 8A Adjustable Power Supply, Pt.2.

June 1998: Troubleshooting Your PC, Pt.2; Universal High Energy Ignition System; The Roadies' Friend; 50W Per Channel Universal Stepper Motor Controller; Command Control For Model Railways, Pt.5

July 1998: Troubleshooting Your PC, Pt.3; 15W/Ch Class-A Audio Amplifier, Pt.1: Simple Charger For 6V & 12V SLA Batteries; Automatic Sensitive Flasher; Low-Cost Electronic Ignition Lighting, Pt.8.

August 1998: Troubleshooting Your PC, Pt.4; I/O Card With Data Logging; Beat Triggered Strobe; 15W/Ch Class-A Stereo Amplifier, Pt.2.

September 1998: Troubleshooting Your PC, Pt.5; A Blocked Air-Filter Alarm; Waa-Waa Pedal For Guitars; Jacob's Ladder; Gear Change Indicator For Cars; Capacity Indicator For Rechargeable Batteries.

October 1998: AC Millivoltmeter, Pt.1; PC-Controlled Stress-O-Meter; Versatile Electronic Guitar Limiter; 12V Trickle Charger For Float Conditions; Adding An External Battery Pack To Your Flashgun.

November 1998: The Christmas Star; A Turbo Timer For Cars; Build A Poker Machine, Pt.1; FM Transmitter For Musicians; Lab Quality AC Millivoltmeter, Pt.2; Improving AM Radio Reception, Pt.1.

December 1998: Engine Immobiliser Mk.2: Thermocouple Adaptor For DMMs; Regulated 12V DC Plugpack; Build A Poker Machine, Pt.2; Improving AM Radio Reception, Pt.2; Mixer Module For F3B Gliders.

January 1999: High-Voltage Megohm Tester; A Look At The BASIC Stamp; Bargraph Ammeter For Cars; Keypad Engine Immobiliser.

March 1999: Build A Digital Anemometer; DIY PIC Programmer; Build An Audio Compressor; Low-Distortion Audio Signal Generator, Pt.2.

April 1999: Getting Started With Linux, Pt.2; High-Power Electric Fence Controller; Bass Cube Subwoofer; Programmable Thermostat/Thermometer; Build An Infrared Sentry; Rev Limiter For Cars.

May 1999: The Line Dancer Robot; An X-Y Table With Stepper Motor Control, Pt.1; Three Electric Fence Testers; Carbon Monoxide Alarm.

June 1999: FM Radio Tuner Card For PCs; X-Y Table With Stepper Motor Control, Pt.2; Programmable Ignition Timing Module For Cars, Pt.1.

July 1999: Build A Dog Silencer; 10µH to 19.99mH Inductance Meter; Audio-Video Transmitter; Programmable Ignition Timing Module For Cars, Pt.2; XYZ Table With Stepper Motor Control, Pt.3.

August 1999: Remote Modem Controller; Daytime Running Lights For Cars; Build A PC Monitor Checker; Switching Temperature Controller; XYZ Table With Stepper Motor Control, Pt.4; Electric Lighting, Pt.14.

September 1999: Autonomouse The Robot, Pt.1; Voice Direct Speech Recognition Module; Digital Electrolytic Capacitance Meter; XYZ Table With Stepper Motor Control, Pt.5; Peltier-Powered Gas Cooler.

October 1999: Build The Railpower Model Train Controller, Pt.1; Semiconductor Curve Tracer; Autonomouse The Robot, Pt.2; XYZ Table With Stepper Motor Control, Pt.6; Introducing Home Theatre.

November 1999: Setting Up An Email Server; Speed Alarm For Cars, Pt.1; LED Christmas Tree; Intercom Station Expander; Foldback Loudspeaker System; Railpower Model Train Controller, Pt.2.

December 1999: Solar Panel Regulator; PC Powerhouse (gives +12V, +9V, +6V & +5V rails); Fortune Finder Metal Locator; Speed Alarm For Cars, Pt.2; Remote Control Thermometer, Pt.3; Index to Vol.12

January 2000: Spring Reverberation Module; An Audio-Video Test Generator; Parallel Port Interface Card; Telephone Off-Hook Indicator.

February 2000: Multi-Sector Sprinkler Controller; A Digital Voltmeter For Your Car; Safety Switch Checker; Sine/Square Wave Oscillator.

March 2000: 100W Amplifier Module, Pt.1; Electronic Wind Vane With 16-LED Display; Build A Glowplug Driver.

May 2000: Ultra-LD Stereo Amplifier, Pt.2; LED Dice (With PIC Microcontroller); SCADA Motor Speed Controller For Models

June 2000: Automatic Rain Gauge; Parallel Port VHF FM Receiver; Switchmode Power Supply (1.23V to 40V) Pt.1; CD Compressor.

July 2000: Moving Message Display; Compact Fluorescent Lamp Driver; Musicians' Lead Tester; Switchmode Power Supply, Pt.2.

August 2000: Theremin: Spinner (writes messages in "thin-air"); Proximity Switch; Structured Cabling For Computer Networks.

September 2000: Swimming Pool Alarm; 6-Channel PC Relay Board; Dual Motor Speed Controller, Pt.1; Protoboards – The Easy Way Into Electronics, Pt.1; Cybug The Solar Fly.

October 2000: Guitar Jammer; Breath Tester; Wand-Mounted Inspection Camera; Subwoofer For Cars; Fuel Mixture Display, Pt.2.

November 2000: Santa & Rudolf Chrissie Display; 2-Channel Guitar Preamplifier; Fuel Mixture Display & Missed Call Alert; Protoboards – The Easy Way Into Electronics, Pt.3.

December 2000: Home Networking For Shared Internet Access; White LED Torch; 2-Channel Guitar Preamplifier, Pt.2 (Digital Reverb); Driving An LCD From The Parallel Port; Index to Vol.13.

January 2001: How To Transfer LPs & Tapes To CD: The LP Doctor – Clean Up Clicks & Pops, Pt.1; Arbitrary Waveform Generator; 2-Channel Guitar Preamplifier, Pt.3; PIC Programmer & TestBed.

February 2001: An Easy Way To Make PC Boards; Lil' Pulser Train Controller; A MIDI Interface For Musos; Tube Bass Blazer; 2-Metre Groundplane Antenna; LP Doctor – Clean Up Clicks & Pops, Pt.2.

March 2001: Making Photo Resist PC Boards; Big-Digit 12/24 Hour Clock; Parallel Port PIC Programmer & Checkerboard; Protoboards – The Easy Way Into Electronics, Pt.4; 3-Range MIDI Expansion Box.

April 2001: A GPS Module For Your PC; Dr Video – An Easy-To-Build Video Stabiliser; Tremolo Unit For Musicians; Minimitter FM Stereo Transmitter; Intelligent Nicad Battery Charger.

May 2001: 12V Mini Stereo Amplifier; Two White-LED Torches To Build; PowerPIC – A Multi-Purpose PIC Programmer Using Linux To Share An Internet Connection, Pt.1; Tweaking Windows With TweakUI.

June 2001: Universal Battery Charger, Pt.1; Phonome – Call, Listen In & Switch Devices On & Off; Low-Cost Automatic Camera Switcher; Using Linux To Share An Internet Connection, Pt.3.

July 2001: The HeartMate Heart Rate Monitor; Do Not Disturb Telephone Timer; Pic-Toc – A Simple Alarm Clock; Fast Universal Battery Charger, Pt.2; Backing Up Your Email.

August 2001: DI Box For Musicians; 200W Mosfet Amplifier Module; Headlight Reminder; 40MHz-6 Digit Frequency Counter Module; Using Linux To Share An Internet Connection, Pt.3.

September 2001: Making MP3s; Build An MP3 Jukebox, Pt.1; PC-Controlled Mains Switch; Personal Noise Source For Tinnitus; Directional Microphone Using Two PCs; Using Linux To Share an Internet Connection, Pt.4.

November 2001: Ultra-LD 100W/Channel Stereo Amplifier, Pt.1; Neon Tube Modulator For Cars; Audio/Video Distribution Amplifier; Build A Short Message Recorder Player To Send Your Voice By Email.

January 2002: Touch And/Or Remote-Controlled Light Dimmer, Pt.1; A Cheap 'n'Easy Motorbike Alarm; 100W/Channel Stereo Amplifier, Pt.3; Build A Raucous Alarm; FAQs On The MP3 Jukebox.

February 2002: 10-Channel IR Remote Control Receiver; 2.4GHz High-Power Audio-Video Link; Touch And/Or Remote-Controlled Light Dimmer, Pt.2; Booting A PC Without A Keyboard; 4-Way Event Timer.

March 2002: Mighty Midget Audio Amplifier Module; 6-Channel IR Remote Volume Control, Pt.1; RIAA Pre-Amplifier For Magnetic Cartridges; 12/24V Intelligent Solar Power Battery Charger.

April 2002: Automatic Single-Channel Light Dimmer; Pt.1: Water Level Indicator; Multiple-Output Bench Power Supply; Versatile Multi-Mode Timer; 6-Channel IR Remote Volume Control, Pt.2.

May 2002: 32-LED Knightrider; The Battery Guardian (Cuts Power When the Battery Voltage Drops); Stereo Headphone Amplifier; Automatic Single-Channel Light Dimmer; Pt.2; Stepper Motor Controller.

August 2002: Digital Instrumentation Software For PCs; Digital Storage

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September 2002: 12V Fluorescent Lamp Inverter; 8-Channel Infrared Remote Control; 50-Watt DC Electronic Load; Spyware – An Update.

October 2002: Speed Controller For Universal Motors; PC Parallel Port Wizard; Cable Tracer; AVR ISP Serial Programmer; 3D TV.

November 2002: SuperCharger For NiCd/NiMH Batteries, Pt.1; Windows-Based EPROM Programmer, Pt.1; 4-Digit Crystal-Controlled Timing Module.

December 2002: Receiving TV From Satellites; Pt.1; The Micromitter Stereo FM Transmitter; Windows-Based EPROM Programmer, Pt.2; SuperCharger For NiCd/NiMH Batteries; Pt.2; Simple VHF FM/AM Radio.

January 2003: Receiving TV From Satellites, Pt. 2: SC480 50W RMS Amplifier Module, Pt.1; Gear Indicator For Cars; Active 3-Way Crossover For Speakers.

February 2003: PortaPal PA System, Pt.1; SC480 50W RMS Amplifier Module, Pt.2; Windows-Based EPROM Programmer, Pt.3; Fun With The PICAXE, Pt.1.

March 2003: LED Lighting For Your Car; Peltier-Effect Tinnie Cooler; PortaPal PA System, Pt.2; Cars That Talk, Pt.1; Real-Time Clock/Calendar Subwoofer; Fun With The PICAXE, Pt.2 (Shop Door Minder).

April 2003: Video-Audio Booster For Home Theatre Systems; Telephone Dialler For Burglar Alarms; Three PIC Programmer Kits; PICAXE, Pt.3 (Heartbeat Simulator); Electric Shutter Release For Cameras.

May 2003: Widgybox Guitar Distortion Effects Unit; 10MHz Big Blaster Subwoofer; Printer Port Simulator; PICAXE, Pt.4 (Motor Controller).

June 2003: PICAXE-Controlled Telephone Intercom; Sunset Switch For Security & Garden Lighting; Digital Reaction Timer; Adjustable DC-DC Converter For Cars; Long-Range 4-Channel UHF Remote Control.

July 2003: Smart Card Reader & Programmer; Power-Up Auto Mains Switch; A "Smart" Stand-Alone Programmable Combination Lock; Testing Updating The PIC Programmer & Checkerboard.

August 2003: PC Infrared Remote Receiver (Play DVDs & MP3s On Your PC Via Remote Control); Digital Instrument Display For Cars, Pt.1; Home-Brew Weatherproof 2.4GHz Antenna For Wireless PICAXE Nets.

September 2003: Robot Wars; Krypton Bike Light; PIC Programmer; Current Clamp Meter Adaptor For DMMs; PICAXE Pt.8 – A Data Logger; Digital Instrument Display For Cars, Pt.2.

October 2003: PC Board Design, Pt.1; JVC0 Loudspeaker System; A Dirt Cheap, High-Current Power Supply; Low-Cost 50MHz Frequency Meter; Long-Range 16-Channel Remote Control System.

November 2003: PC Board Design, Pt.2; 12AX7 Valve Audio Preamplifier; Our Best Ever Stereo Amplifier; Data Modem For Microcontrollers; PICAXE Pt.9, Programmable PIC-Powered Timer.

December 2003: PC Board Design, Pt.3; VHF Receiver For Weather Satellites; Linear Supply For Luxeon 1W Star LEDs, 5V Meter Calibration Standard; PIC-Based Sat Receiver Monitor; PICAXE Pt.10.

January 2004: Studio 350W Power Amplifier Module, Pt.1; High-Efficiency Power Supply For 1W Star LEDs; Remote & RF Preamp For Weather Satellites; Lapel Microphone Adaptor For PA Systems; PICAXE-18X 4-Channel Datalogger, Pt.1; 2.4GHz Audio/Video Link.

February 2004: PC Board Design, Pt.1: Supply Rail Monitor For PCs; Studio 350W Power Amplifier Module, Pt.2; Shortest Turns Tester For Line Output Transformers; PICAXE-18X 4-Channel Datalogger, Pt.2.

March 2004: PC Board Design, Pt.2; Build The QuickBrake For Increased Driving Safety; 3V-9V (or more) DC-DC Converter; ESR Meter Mk.2, Pt.1; PICAXE-18X 4-Channel Datalogger, Pt.3.

April 2004: PC Board Design, Pt.3; Loudspeaker Level Meter For Home Theatre Systems; Dog Silencer; Mixture Display For Cars; ESR Meter Mk.2, Pt.2; PC/PICAXE Interface For Data Logging & Monitor.

May 2004: Amplifier Testing Without High-Tech Gear; Component Video To RGB Converter; Starpower Switching Supply For Luxeon Star LEDs; Wireless Parallel Port; Poor Man's Metal Locator.

June 2004: Build An RFID Security Module; Simple Fridge-Door Alarm; Courtesy Light Delay For Cars; Programming PC Power-Up; Upgraded Software For The EPROM Programmer.

July 2004: Silencing A Noisy PC; Versatile Battery Protector; Appliance Energy Meter, Pt.1; A Poor Man's Q Meter; Regulated High-Voltage Supply For Valve Amplifiers; Build A Wireless Mouse Trap Alarm.

August 2004: Video Formats: Why Bother?; VAF's New DC-X Generation IV Loudspeakers; Video Enhancer & Y/C Separator; Balanced Microphone Preamp; Appliance Energy Meter, Pt.2; 3-State Logic Probe.

September 2004: Voice Over IP (VoIP) For Beginners; WiFry – Cooking 2.4GHz Antennas; Bed Wetting Alert; Build a Programmable Robot; Another CFL Inverter.

October 2004: The Humble "Trannie" Turns 50; SMS Controller, Pt.1; RGB To Component Video Converter; USB Power Injector; Remote Controller For Garage Doors & Gates.

November 2004: 42V Car Electrical Systems; USB-Controlled Power Switch (Errata December 2004); Charger For Deep-Cycle 12V Batteries, Pt.1; Driveway Sentry For Cars; SMS Controller, Pt.2; PICAXE IR Remote Control.

December 2004: Build A Windmill Generator, Pt.1; 20W Amplifier Module; Charger For Deep-Cycle 12V Batteries, Pt.2; Solar-Powered Wireless Weather Station; Bidirectional Motor Speed Controller.

January 2005: Windmill Generator, Pt.2; Build A VB Doorbell; IR Remote Control Checker; 4-Minute Shower Timer; The Prawnlite; Sinom Says Game; VAF DC-7 Generation 4 Kit Speakers.

February 2005: Windmill Generator, Pt.3; USB-Controlled Electrocardiograph; Twin-Tec Stereo Amplifier; Inductance & Q-Factor Meter, Pt.1; A Yagi Antenna For UHF CB; $2 Battery Charger.

March 2005: Windmill Generator, Pt.4; Sports Scoreboard, Pt.1; Inductance & Q-Factor Meter, Pt.2; Shielded Loop Antenna For AM; Sending Picaxe Data Over 477MHz UHF CB; $10 Lathe & Drill Press Tachometer.

April 2005: Install Your Own In-Car Video (Reversing Monitor); Build A MIDI Theremin, Pt.1; Bass Extender For Hifi Systems; Sports Scoreboard, Pt.2; SMS Controller Add-Ons; A 5c Variable Power Supply.

May 2005: Getting Into Wi-Fi, Pt.1; Build A 45-Second Voice Recorder; Wireless Microphone/Audio Link; MIDI Theremin, Pt.2; Sports Scoreboard, Pt.3; Automatic Stopwatch Timer.

June 2005: Wi-Fi, Pt.2; The Messmeriser LED Clock; Cool/Inster Fridge/ Freezer Temperature Controller; Sensitive Power Regular; PICAXE Colour Recognition System; AVR200 Single Board Computer, Pt.1.

July 2005: Wi-Fi, Pt.3; Remote-Controlled Automatic Lamp Dimmer; Serial Stepper Motor Controller; Salvaging & Using Thermostats; Unwired Modems & External Antennas.

August 2005: Mudlark A205 Valve Stereo Amplifier, Pt.1; Programmable Rixelitimer; Carbon Monoxide Alert; Serial LCD Driver; Enhanced Sports Scoreboard; Salvaging Washing Machine Pressure Switches.

September 2005: Build Your Own Loudspeakers; Bilge Sniffer For Boats; VoIP Analog Phone Adaptor; Mudlark A205 Valve Stereo Amplifier, Pt.2; PICAXE in Schools, Pt.4.

October 2005: A Look At Google Earth; Dead Simple USB Breakout Box; Studio Series Stereo Preamplifier, Pt.1; Video Reading Aid For Vision Impaired People; Simple Alcohol Level Meter; Ceiling Fan Timer.

November 2005: Good Quality Car Sound On The Cheap; Pt.1; PICAXE In Schools, Pt.5; Studio Series Stereo Headphone Amplifier; Build A MIDI Drum Kit, Pt.1; Serial I/O Controller & Analog Sampler.

December 2005: Good Quality Car Sound On The Cheap; Pt.2; Building The Ultimate Jukebox, Pt.1; Universal High-Energy Ignition System; Pt.1; MIDI Drum Kit, Pt.2; 433MHz Wireless Data Communication.

January 2006: Pocket TENS Unit For Pain Relief; "Little Jim" AM Radio Transmitter; Universal High-Energy Ignition System, Pt.2; Building The Ultimate Jukebox, Pt.2; MIDI Drum Kit, Pt.3; Picaxe-Based 433MHz Wireless Thermometer; A Human-Powered LED Torch.

February 2006: PC-Controlled Burglar Alarm, Pt.1; A Charger For iPods & MP3 Players; Picaxe-Based Refrigerator Temperature Display; Build A MIDI Drum Kit, Pt.4; Building The Ultimate Jukebox, Pt.3.

March 2006: The Electronic Camera, Pt.1; PC-Controlled Burglar Alarm System, Pt.2; Low-Cost Intercooler Water Spray Controller; AVR ISP Socket/Board; Build A Video Sync Stripper For Oscilloscopes.

April 2006: The Electronic Camera, Pt.2; Studio Series Remote Control Module (For A Stereo Preamplifier); 4-Channel Audio/Video Selector; Universal High-Energy Led Lighting System, Pt.1; Picaxe Goes Wireless, Pt.1 (Using the 2.4GHz Data Modules).

May 2006: Lead-Acid Battery Zapper; Universal High-Energy LED Lighting System, Pt.2; Passive Direct Injection (DI) Box For Musicians; Picaxe Goes Wireless, Pt.2; Boost Your Xbee's Range Using Simple Antennas.

June 2006: Pocket A/V Test Pattern Generator; Two-Way SPDIF-to-Toslink Digital Audio Switch For A 2.4GHz Wireless A/V Link; A High-Current Battery Charger For Almost Nothing.

July 2006: Mini Theremin Mk.2, Pt.1; Programmable Analog On-Off Controller; Studio Series Stereo Preamplifier; Stop Those Zaps From Double-Insulated Equipment.

August 2006: Picaxe-Based LED Chaser Clock; Magnetic Cartridge Preamplifier; An Ultrasonic Eavesdropper; Mini Theremin Mk.2, Pt.2.

September 2006: Transferring Your LPs To CDs & MP3s; Turn an Old Xbox Into A $200 Multimedia Player; Build The Galactic Voice; Aquarium Temperature Monitor; PIC-Based Video Combiner.

October 2006: LED Tachometer With Dual Displays, Pt.1; UHF Prescaler For Frequency Counters; Infrared Remote Control Extender; Easy-To-Build 12V Digital Timer Module; Build A Super Bicycle Light Alternator.

November 2006: Radar Speed Gun, Pt.1; Build Your Own Compact Base Reflex Loudspeaker Enclosures; Temperature Star; DC Relay Switch; LED Tachometer With Dual Displays, Pt.2; Picaxe Net Server, Pt.3.

December 2006: Bringing A Dead Cordless Drill Back To Life; Cordless Power Tool Charger Controller; Build A Radar Speed Gun, Pt.2; Super Speedo Corrector; 12/24V Battery Capacity Meter, Pt.1.

January 2007: Versatile Temperature Switch; Intelligent Car Air-Conditioning Controller; Remote Telltale For Garage Doors; Intelligent 12V Charger For SLA & Lead-Acid Batteries.

February 2007: Remote Volume Control & Preamplifier Module, Pt.1; Simple Variable Power Supply; Turbo Cool Fan Temp Controller For The Boost Control; Low-Cost 50MHz Frequency Meter, Mk.2.

March 2007: Programmable Ignition System For Cars, Pt.1; Remote Volume Control & Preamplifier Module, Pt.2; GPS-Based Frequency Reference, Pt.1; Simple Ammeter & Voltmeter.

April 2007: High-Power Reversible DC Motor Speed Controller; Build A Jacob's Ladder; GPS-Based Frequency Reference, Pt.2; Programmable Ignition System, Pt.2; Dual PICAXE Infrared Data Communication.

May 2007: 20W Class-A Amplifier Module, Pt.1; Adjustable 1.3-25V Regulated Power Supply; VU/Peak Meter With LCD Bargraphs; Programmable Ignition System For Cars, Pt.3; GPS-Based Frequency Reference Modifications; Throttle Interface For The DC Motor Speed Controller.

June 2007: 20W Class-A Amplifier Module, Pt.2; Knock Detector For The Programmable Ignition; 4-Input Mixer With Tone Controls; Frequency-Activated Switch For Cars; Simple Panel Meters Revisited.

July 2007: How To Cut Your Greenhouse Emissions; Pt.1: 6-Digit Nixie Clock, Pt.1; Tank Water Level Indicator; A PID Temperature Controller; 20W Class-A Stereo Amplifier; Pt.3; Making Panels For Projects.

August 2007: How To Cut Your Greenhouse Emissions, Pt.2: 20W Class-A Stereo Amplifier, Pt.4; Adaptive Turbo Timer; Subwoofer Controller; 6-Digit Nixie Clock, Pt.2.

September 2007: The Art Of Long-Distance WiFi; Fast Charger For NiMH & Nicad Batteries; Simple Data-Logging Weather Station, Pt.1; 20W Class-A Stereo Amplifier; Pt.5.

October 2007: DVD Players – How Good Are They for Hifi Audio?; PICProbe Logic Probe, Pulser, Probing Code Security System, Pt.1; Simple Data-Logging Weather Station, Pt.2; AM Loop Antenna & Amplifier.

November 2007: Your Own Home Recording Studio; PIC-Based Water Tank Level Meter, Pt.1; Playback Adaptor For CD-ROM Drives, Pt.1; Rolling Code Security System, Pt.2.

December 2007: Signature Series Kit Loudspeakers; IR Audio Headphone Extender; Linux-Based 4-Channel Recorder Module; PIC-Based Water-Tank Level Meter; Pt.2; Playback Adaptor For CD-ROM Drives; Pt.2.

January 2008: PIC-Controlled Swimming Pool Alarm; Emergency 12V Lighting Controller; Build The "Aussie-3" Valve AM Radio; The Minispot 433MHz Miniature Radio Oscillator Module; Water Tank Level Meter, Pt.3 – The Base Station; Improving The Water Tank Level Meter Pressure Sensor.

February 2008: UHF Remote-Controlled Mains Switch; UHF Remote Mains Switch Transmitter; A PIR-Triggered Mains Switch; Shift Indicator & Rev Limiter For Cars; Mini Solar Battery Charger.

March 2008: The I²C Bus – A Quick Primer; 12V-24V High-Current DC Motor Speed Controller; Pt.1: A Digital VFO with LCD Graphics Display; A Low-Cost PC-to-I²C Interface For Debugging.

April 2008: Charge Controller For 12V Lead-Acid Or SLA Batteries; Safe Flash Trigger For Digital Cameras; 12V-24V High-Current DC Motor Speed Controller, Pt.2; Two-Way Stereo Headphone Adaptor.

May 2008: Replacement CDI Module For Small Petrol Motors; High-Accuracy Digital LC Meter; Low-Cost dsPIC/PIC Programmer; High-Current Adjustable Voltage Regulator.

June 2008: DSP Musicolour Light Show, Pt.1; PIC-Based Flexitimer Mk.4; USB Power Injector For External Hard Drives; Balanced/Unbalanced Converter For Audio Signals; A Quick'n'Easy Digital Slide Scanner.

July 2008: DSP Musicolour Light Show, Pt.2; A PIC-Based Musical Tuning Aid; Battery Desulfator For PCs & MP3 Players; Bridge Adaptor For Stereo Power Amplifiers.

August 2008: Ultra-LD Mk.2 200W Power Amplifier Module, Pt.1; Planet Jupiter Remote; LED Strobe & Contactless Tachometer, Pt.1; DSP Musicolour Light Show, Pt.3; Pranking In The Digital Playground.

September 2008: Railpower Model Train Controller, Pt.1; LED/Lamp Flasher; Ultra-LD Mk.2 200W Power Amplifier Module, Pt.2; DSP Musicolour Light Show, Pt.4; LED Strobe & Contactless Tachometer, Pt.2.

October 2008: USB Clock With LCD Readout, Pt.1; Digital RF Level & Power Meter; Multi-Purpose Railpower Model Train Controller, Pt.2; Picaxe-08M 433MHz Data Transceiver.

November 2008: 12V Speed Controller/Lamp Dimmer; USB Clock With LCD Readout, Pt.2; Wideband Low-Fuel Mixture Display Unit; IrDA Interface Board For The DSP Musicolour; The Ambi-Radiator.

December 2008: Versatile Car Scrolling Display, Pt.1; Test The salt Content Of Your Swimming Pool; Build A Browncoat Detector; Simple Voltage Switch For 12V Sensors.

January 2009: Dual Booting With Two Hard Disk Drives; USB-Sensing Mains Power Switch; Remote Mains Relay Mk.2; AM Broadcast Band Loop Antenna; Car Scrolling Display, Pt.2; 433MHz UHF Remote Switch.

February 2009: Digital Radio Is Coming, Pt.1; Tempmaster Electronic Thermostat Mk.2; 10A Universal Motor Speed Controller Mk.2; Programmable Time Delay Flash Trigger; Car Scrolling Display, Pt.3.

March 2009: Reviving Old Laptops With Puppy Linux; Digital Radio Is Coming, Pt.2; A GPS-Synchronised Clock; Thermite Mk.2; Build A Digital Audio Oscilloscope; Learning about Picaxe Microcontrollers.

April 2009: Digital Radio Is Coming, Pt.3; Wireless Networking With Ubuntu & Puppy Linux; Remote-Controlled Lamp Dimmer; Digital Audio Oscilloscope, Pt.2; Simple Short Circuit Switch; Microcurrent DMM Adaptor.

May 2009: A 6-Digit GPS-Locked Clock, Pt.1, 230VAC 10A Full-Wave Motor Speed Controller; Precision 10V DC Reference For Checking DMMs; UHF Remote 2-Channel 230VAC Power Switch; Drawing Circuits For The Digital Audio Millivoltmeter; Drawing Circuits In Protel Autotrax.

June 2009: Mal's Electric Vehicle Conversion; High-Current, High-Voltage Battery Capacity Meter, Pt.1; GPS Driver Module For 6-Digit Clock; A Beam-Break Flash Trigger; Hand-Held Digital Audio Oscillator.

July 2009: The Magic Of Water Desalination; Lead-Acid Battery Zapper & Desulphator; Hand-Held Metal Locator; Multi-Function Active Filter Module; High-Current, High-Voltage Battery Capacity Meter, Pt.2.

August 2009: Converting A Uniden Scanner To Pick Up AIS Signals; An SD Card Music & Speech Recorder/Player; Lead-Acid/SLA Battery Condition Checker; 3-Channel UHF Rolling-Code Remote Control, Pt.1.

September 2009: High-Quality Stereo Digital-To-Analog Converter, Pt.1; Wideband Thermocouple Adaptor For DMMs; Pt.1: Modern Add-On For The GPS Clock; 3-Channel UHF Rolling-Code Remote Control, Pt.2.

October 2009: Universal I/O Board With USB Interface; High-Quality Stereo Digital-To-Analog Converter, Pt.2; Digital Megohm & Leakage Current Meter; Wideband Oscilloscope Sensor Controller For Cars, Pt.2.

November 2009: Web Server In A Box, Pt.1; Twin-Engine Speed-Match Indicator For Boats; High-Quality Stereo Digital-To-Analog Converter, Pt.3; A Dead-Simple Masthead Amplifier.

December 2009: Voltage Interceptor For Car Sensors, Pt.1; One-Of-Nine Switch Position Indicator; Capacitor Leakage Meter With LCD; Big 7-Segment LED Panel Meter Display; Web Server In A Box, Pt.2.

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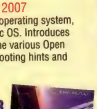

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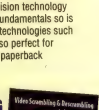

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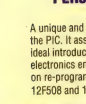

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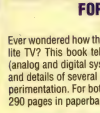

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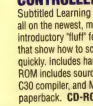

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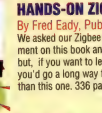

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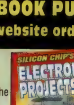

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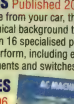

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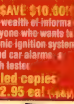

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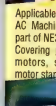

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by K.F. Ibrahim. Published 2003.

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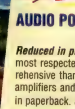
As reviewed in SILICON CHIP February 2004.



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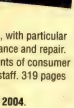

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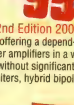

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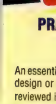

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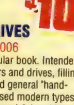

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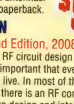

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NiMH cells can charge up to 2V

I have built the Fast NiMH Charger featured in the September 2007 issue and I have a question regarding the output voltage. Nowhere in the article does it indicate where one sets the output voltage for the unit.

When I hook it up to my NiMH cells it basically charges a 7.2V bank at 12V. It seems to follow all the correct cut-off procedures etc but it still worries me that I am charging the batteries at this level. Any suggestion will be greatly appreciated. (D. B., via email).

● The charging voltage depends on charge rate and the amount of cell charge. Typically, the cell voltage can rise to 2V when charging. So for your 7.2V battery with six cells it is normal for the battery to be at 12V while charging. End of charge is detected by the temperature rise.

Note that NiMH and Nicad cells are very different to lead-acid batteries where it is the voltage that determines end of charge.

Residual voltage in Screecher car alarm

I completed the Screecher car alarm kit described in the January 1999 issue of *Electronics Australia*. The alarm is connected to IN1 to the door switch and is working but I have one issue.

There is a residual voltage of 1.7V which lights the LED when the unit is not powered and the doors are closed. Currently the alarm is working with the LED disconnected.

Could you please provide me guidance on what could I do to remove this residual voltage and allow me to use the LED as per normal operation for the alarm kit? (C. L., via email).

● Try connecting a 4.7kΩ resistor between the base and emitter of transistor Q1, the LED driver.

Fast charger will not terminate

I am having troubles with the Fast NiMH Charger featured in the September 2007 issue. I am charging four Nicad sub-C cells in a 1.8Ah battery pack. I set up the charger as in the text of the article with a 600mA charge, 1.25V on VR2 and I also tried the 2.5V setting, as recommended. VR1 is at 5V to give five hours and links LK1-2-3 not on.

While monitoring the voltage across the battery I can see the peak and its turn down while charging. I also monitored the temperature of the cell with an RTD temperature instrument where the thermistor is fitted. The two readings above were taken every five minutes. The temperature rise was only 3°C in five minutes (at best) but most of the time it was 1°C in five minutes. I terminated the test at a battery temperature of 50°C.

Is there something I am missing, eg, does the 55°C stop charging? Or does the 5-hour time limit stop charging? If so, that means the battery will get very hot because at this stage only about 2.5 hours has passed. (F. N., via email).

● Charging will stop at 55°C. If the cell temperature rise is less than the dT/dt setting, then the charger will not stop charging until the cell reaches 55°C or the timer times out. Maybe you should set dT/dt to 0.5°C per minute and then it should switch off when charged. You can reduce the time-out period to suit the cells. This will ensure the charger switches off even if the dT/dt detection is not tripped.

We presume the cells are 1.8Ah and so the 600mA charge rate is OK. The dT/dt rise for the cells will be higher with a higher charge current. Your 600mA charge current setting does not appear to give sufficient heat rise at the end point. Check that the supply you are using does actually deliver 600mA.

Frequency switch controls bike headlight

A few months ago I bought a Frequency Switch kit, as published in the June 2007 issue. We mounted it on a motorbike to turn on the headlight at an engine of speed 1000 RPM. The frequency ranges for this kit are 10-100Hz (600-6000 RPM) and 50-500Hz (3000-30,000 RPM). We used the first one but in fact engine speed is up to 14,000 RPM and the headlight starts blinking at 6000 RPM. We need a range of 1000-14,000 RPM.

Can I adjust trimpot VR2 to set a suitable range (somewhere between first and second)? Or would you advise the use of an additional (locking) relay? (J. V., Estonia).

● Adjusting trimpot VR1 should set the unit to cover the range from 1000-14,000 RPM.

You could set the relay to latch when 1000 RPM is reached by connecting the common (COM) terminal of one of the

Advice Wanted On HDTV Antenna Installation

I have recently purchased a HDTV and need to install an antenna plus cabling. Can you please advise as to what I may need to do an installation, ie, antenna, cabling, terminations etc? I live Canberra. (M. F., Chifley, ACT).

● If you presently have good analog TV reception, there is little reason to change your antenna installation.

Apart from that, it is not really possible for us to give you detailed advice on a complete installation, particularly as you may need multiple sockets, splitters and a masthead amplifier and so on. It all depends on your particular requirements.

However, we do sell a good reference book which will guide you in choosing the necessary hardware. Called "TV Across Australia", it is available from SILICON CHIP for $49.95 plus $10 postage and packing.

contacts to ground and the normally open (NO) contact to the anode of diode D4. The second contact set of the relay switches the headlight.

Digital thermostat wanted

I am working on a Ford 1993 NC II Fairlane and I want to install a separate transmission cooler because the radiator cooler is shedding brass fragments. I want a digital/LED temperature gauge and an electronic sender to install in the return pipe from the transmission.

I am also looking for an electronic thermostat to switch on a 12V electric cooling fan, preferably in the same circuit. (L. W., Ashbury, NSW).

- The High-Temperature Digital Thermometer, as featured in SILICON CHIP's *Performance Electronics for Cars*, would do the job. This has an adjustable temperature switch and temperature display and is sold as a kit by Jaycar Electronics (Cat. KC-5376).

Note that the temperature probe must be an insulated type as detailed in the article. A non-insulated probe would need to be isolated from the return pipe of the transmission.

Ultrasonic cleaners need little explanation

I was wondering if it would be possible for SILICON CHIP to do a project on ultrasonic cleaners, as learning while building a project is always the best way to understand the principles involved. (J. G., Doveton, Vic).

- There's really not much to ultrasonic cleaners. Basically you have a stainless steel tank with a piezoelectric transducer epoxied to the bottom. The piezo is fed with a high power ultrasonic signal which passes through the cleaning solution (usually a weak detergent) to shake all the dirt out of the object being cleaned in the tank.

However, we will look at the feasibility of doing an ultrasonic cleaner project.

Non-contact tachometer wanted for chainsaw

Would you consider producing a construction article to make a non contact electronic tacho? My specific requirement is to measure the RPM of a chainsaw where there is no ready access to the spark plug or lead while the chainsaw is assembled and running.

I imagine it may be feasible to use some form of capacitive coupling to a probe near the spark plug cable and display the RPM on an analog meter without undue complexity or cost. The unit could, of course, be made more versatile by accommodating both 2-stroke, 4-stroke and multi-cylinder motors. (A. G., Bankstown, NSW).

- We published a LED Strobe & Tachometer in the August & September 2008 issues. This is directly suited to your application.

Running the Mixture Display from 9V

I am currently making your Mixture Display kit for fuel-injected cars. I plan to use it on my super kart. Will this kit work with a 9V battery or does it require 12V?

I am also looking for a temperature warning light circuit using a thermocouple. Do you have an article that I can download that has the circuit and part list? (J. J., Auckland, NZ).

- The Mixture Display will run on 9V. If using a 216 type 9V battery, the display should be set only to dot mode not bargraph, as the current needs to be kept to a minimum. Current drain with dot mode is around 10mA.

The High-Temperature Digital Thermometer as published in SILICON CHIP's *Performance Electronics for Cars* and also sold as a kit by Jaycar (KC-5376)

Speedo Corrector For A Nissan Patrol

I have recently put together the Speedo Corrector from the December 2006 issue and have connected it to a 2000 Nissan Patrol. The initial set-up and validity check works fine and I can get a 1Hz output from the LED using either LK1 or LK2 with S1 at "2" and S2 at "A".

However, if I reposition switches S1 & S2 back to "0" I can only get an output at the speedo using LK1 (5V path). Also, I have found that I must utilise LK4 to make the speedo work (no problem with this) but then the speedo bounces, ie, it will give an output for a few seconds before falling away to 0, then come back again. As the speed increases above about 70km/h, the speedo falls away altogether. I cannot get the speedo to give a steady or linear output.

I have checked the switched DC input to the Speedo Corrector and confirmed 14.5V (engine running). The earth is sound (no resistance) and I have removed the input/output wires from the kit and connected them together via terminal strip to see if the speedo functions as it did. This was OK and proved the wiring connections at the instrument cluster. I also tried introducing the "Lag" correction but this did not solve the problem.

I have double-checked the discrete components and solder connections and cannot find an obvious error. Is there any assistance you can provide? (D. O., via email).

- Nissans usually require an AC signal for the speedometer. So use LK5 and try the LK1 and LK2 positions for correct running.

If that does not work, check the transistor types at Q5 and Q6 and check the polarity orientation for the 100µF capacitor at the collector of Q6.

Why Is The PC Output Not As Loud As A CD Player?

Why is it especially noticeable that the sound card output from a PC is not as loud as from a standalone CD player? Both should be putting out line level.

I've heard this question asked a lot of times and although everyone has theories, most of them don't hold true. I'm pretty certain that I know the reason but I'd like to hear it from the experts! You probably also have a much better way of explaining it. (C. M., via email).

- Typical PC sound cards have a maximum output of 1V instead of 2V RMS as from DVD and CD players. This is a reduction of 6dB and is quite noticeable.

Beam Break Trigger Needs Longer Pulse

After constructing the Bream Break Trigger from the June 2009 issue I didn't have any luck getting it to trigger a camera, either directly or via the photoflash trigger kit. Unless I'm missing something, doesn't the 10nF coupling capacitor between Q1 and Q2 lead to a time constant of mere microseconds?

I didn't measure the timing beforehand but after doing a rough calculation I placed a 1µF capacitor in parallel with the 10nF capacitor which lead to a trigger time of somewhere in the order of 10ms and all was fine with the photoflash trigger kit. I left it at that because it's my intention to use it with the trigger kit.

However, readers should be aware that some cameras require a longer pulse on their external trigger to fire. For example, my Canon EOS 450D seems to require a minimum duration of about 60ms in manual focus mode – presumably, if the pulse is shorter than the normal shutter lag time, it gets ignored. Other than that, they are a pair of excellent projects and I am looking forward to exploring the possibilities they offer. (P. J., Lutana, Tas).

- You are correct in that the effective trigger pulse width from the Beam Break Trigger will be only a little over 110µs, as determined by the 10nF capacitor and the total resistance of 11.1kΩ in the charging circuit. The pulse was actually made this short to prevent multiple triggering of the Time Delay Trigger published in the February 2009 issue. However, if you want to use the Beam Break Trigger to trigger a camera directly, that pulse width will be too narrow – as you have pointed out.

Your remedy of increasing the capacitor value from 10nF to 1µF is fine but if this does not give sufficient lengthening of the trigger pulse for some cameras, the resistor from the gate of Q2 to ground can also be increased in value from its present value of 10kΩ. It could be increased to 22kΩ, 47kΩ or even 100kΩ if a much longer pulse is needed.

can be used without the display and relay. A LED is already included to light at a preset temperature.

Mods for bass guitar preamplifier

I was wondering if you have published a design for a bass guitar preamp or would it be possible to modify an existing guitar kit (like the 2-channel guitar preamp) to make the tone controls more suitable for a bass guitar and possibly add a 20Hz cut-off filter? (N. C., via email).

- The 2-channel Guitar Preamplifier from November 2000 can be modified to suit a bass guitar. A 20Hz high-pass filter can be added by changing the 2.2µF capacitor ahead of the 10kΩ level potentiometer (VR1) to 820nF (0.82µF). Steeper roll-off can be included by changing the 2.2µF capacitor at pin 1 of IC1b to 820nF.

The tone controls can be altered for responses at about 35Hz for Bass, 100Hz for Mid and 1kHz for Treble. For the Bass control, the 0.015µF (15nF) capacitor across VR2 is changed to 22nF. The .0027µF (2.7nF) capacitor across VR3 for the Mid control is changed to 27nF and the .012µF (12nF) at VR3's wiper is changed to 120nF. The Treble control is changed with the .0015µF (1.5nF) capacitor at VR4's wiper becoming 15nF. The same changes apply to channel 2.

Beam Break Trigger should be more sensitive

Having built both the Time Delay PhotoFlash Trigger & the Beam-Break Flash Trigger, I am wondering if the Break Beam trigger can be made more sensitive? The unit works very well but it will not detect water droplets falling past the sensor (although larger, heavier objects are no problem).

If this is not possible, could your team look at another add-on photo gate trigger? I believe a Schmitt trigger works better for fast-moving objects such as droplets (B. C., Jewells, NSW).

- We suspect that the main reason why the beam break trigger is not detecting water droplets is because the IR beam from the three LEDs in the IR light source is somewhat wider than the drops. As a result, the drops are not able to cause a significant decrease in the detected IR level as they pass through the beam. If this is the case, you may be able to achieve better operation by trying one or more of these ideas:

(1) Turn the light source box on its side, so the beam will be wider in the vertical plane than in the horizontal plane.
(2) Remove the two side IR LEDs, leaving just the centre one to provide a narrower and relatively circular beam. Note, however, that if you do this, the LEDs you remove will need to be replaced with wire links to complete the circuit. It would also be a good idea to replace the 820Ω series resistor with a 1kΩ resistor, to limit the current drawn by the single remaining LED.
(3) Try cementing a short "beam confining tube" to the front of the IR light source, like the one on the front of the detector box. It should be of brass and preferably with its interior polished.
(4) Try to place the IR input tube of the detector box as close as possible to the axis of the falling drops, so the drops will have maximum impact on the IR radiation entering the tube.
(5) Try adding a small amount of coloured dye to the water source for the drops, so they'll be less transparent to IR radiation.

Measuring audio power with Energy Meter

I am wondering if it is possible to modify the Appliance Energy Meter (SILICON CHIP, July & August 2004) so it can measure audio power through a resistive load? (G. M., via email).

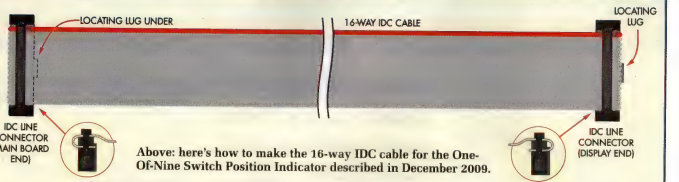
- It is possible. First, the voltage inputs connecting pins 6 & 7 of IC1 to the mains supply (via 2.2MΩ and 1kΩ resistor dividers) would need to be disconnected from the mains supply and connected instead to the amplifier output.

Similarly, the current measurement resistors R1 and R2 (going to input pins 4 & 5 of IC1) would need to be disconnected from the mains and connected so that the amplifier load current flowed through the sense resistor, R1.

Running the Luxeon Star Power from 6V

I have put together a Luxeon Star Power kit and it is being used with

Notes & Errata



Above: here's how to make the 16-way IDC cable for the One-Of-Nine Switch Position Indicator described in December 2009.

One-of-Nine Switch Position Indicator, December 2009: the righthand and bottom sides of the diagram on page 35 were cropped off, omitting vital information on the IDC cable. A full diagram of the IDC cable, showing how the IDC line sockets are fitted, is shown above.

Wideband Controller Pt.2, October 2009: under Step 13 on page 77, the article states that "The voltage between TP7 and TP GND should be 2.5V". This sentence should refer to TP1, not TP7.

Voltage Interceptor For Cars With ECUs, December 2009: there are two errors on the circuit diagram – (1) the 10nF capacitor connected to pin 7 of IC1b should be connected between pins 7 & 6 of that IC; and (2) the 470Ω resistor in series with ZD4 should be connected to V+ instead of V++ (ie, after the 10Ω resistor).

The PC board and parts layout diagram (Fig.5, January 2010) are correct.

There are also several errors in the parts list: ZD2 should be a 15V 1W zener diode; ZD4 should be a 5.6V 1W zener diode; there should be six PC stakes (not five); and there should be seven 10nF MKT polyester capacitors (not six).

Web Server In A Box; December 2009: there is an error in the IP addressing shown on Fig.9(b) on page 84. The addressing scheme shown will not work because a router will only forward packets between different networks (eg, from 192.168.0.x to 192.168.1.x on a class C network and vice versa).

This means that we must use IPs for two different networks on either side of the router, eg, use 192.168.1.1 for the Ethernet port on the modem, 192.168.1.2 on the modem port on the router and leave the switch (or LAN) side of the router at 192.168.0.1. Alternatively, you could assign 10.0.0.1 to the modem, 10.0.0.2 to the modem port on the router and stick with 192.168.0.1 for the LAN side of the router.

A corrected diagram is shown in Pt.3 of the WIB on page 87 of this issue.

a 5W Luxeon. It works well but the question is, is the 7.5V on the circuit board an input or output?

I would like to run the system on about 6V so I can use D-cell rechargeable batteries. Are there mods I can do or is there another kit? (E. P., via email).

● The 7.5V is regulated from the 12V supply and is required for the low-voltage comparator (IC2a) and its reference. The main power required ranges from 11.5-17V. If you want to run it from 6V, then the circuit should work for a single LED but not for two LEDs in series. ZD1, the 7.5V zener diode, should be removed and the 750Ω resistor from diode D2 replaced with a wire link. You can stop the low voltage comparator from switching off the circuit by removing link JP1.

Flickering flame kit runs from batteries

I have the Flickering Flame kit from Jaycar and was wondering how it is

. . . continued on page 103

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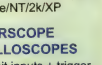

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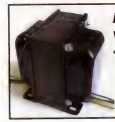

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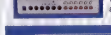

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Jacobs Ladder used as gas igniter

We are currently using your Jacobs Ladder Mk.1 version (SILICON CHIP, September 1995) as a substitute high-energy igniter for a small gas turbine and have been reasonably pleased with the results for static testing. However, we require the spark to be of a higher intensity (hotter and fatter) for our application to properly function, plus we only need it to fire a couple of times a second, although it would be immaterial if the spark were increased in intensity.

We also note that the Mk.1 version has been superseded by the bulkier Mk.2 version (SILICON CHIP, April 2007) that we have yet to try, only because the weight of the unit with the larger, heavier Commodore coil, makes it unsuitable for our application.

So can we get more "grunt" from the unit to get a hotter spark and reduce the number of "firings" and can we use a coil of the same configuration as the Mk.1 uses in the Mk.2? We have been able to utilise a small motorcycle coil with our Mk.1 unit, which places it in a weight and size category we can handle. (A. R., Dandenong, Vic).

- Both versions of the Jacobs Ladder arrangements are the same, especially in the way the 555 timer works, and this is where changes are required. For two sparks per second replace the 330nF capacitor at pins 2 and 6 of IC1 (the 555 timer) with a 1µF MKT polyester. The resistor between pin 7 and the pin 8 supply should be 470kΩ.

The resistor between pins 2 and 6 and to pin 7 can be changed to a value of 5.6kΩ. This value sets the "dwell" (or coil charging period) and can be adjusted to set the spark intensity. A larger value will increase the dwell period and so provide a greater spark.

For some coils, the nominal 4ms dwell may be too long, causing heating in the coil. If so, the 5.6kΩ resistor can be decreased in value to reduce the dwell so that the coil does not heat up but still delivers the required spark intensity.

You can use a motorcycle coil in the circuit instead of the Commodore coil.

. . . continued from page 101

powered and where I can purchase that item from? Also, does the lamp base have negative and positive leads or are they unpolarised? (P. G., via email).

- The Flickering Flame can be powered from any 12V DC source capable of supplying enough current for the light use.

A 12V 20W halogen lamp was specified, so any source capable of delivering 2A would be fine – either a battery or a plugpack supply. The prototype used a supply made up from six 2V 5A SLA cells connected in series.

Finally, halogen lamps are not polarised.

Quiz game with logging

I'd like to build a quiz show console for kids that has three to four buzzers – think Sale of the Century. I'd like to get the output of the first buzzer pushed into a computer so I can log scores, depending on if they get the correct answer.

I haven't been able to find anything on the market that can do this or any circuit diagrams.

Do you have any suggestions on how this could be built and how I can get around problems such as buzzer bounce? (P. M., via email).

- We have published many quiz game circuits, in April 1988, April 1998, January 1990, July 1991, November 1991, December 1991, July 1993, March 1994 and December 2004. Each have an output that is latched when the first button is pressed.

So a computer could monitor the latched output rather than the actual pushbutton. This would avoid the problem with switch contact bounce etc.

We have not published a computer-based adjudicator for games. SC

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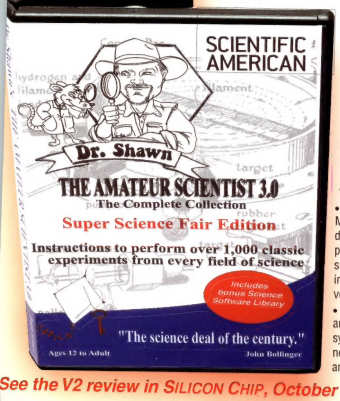

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Electronics Cheat Sheet*

Series Circuits

$V_T = V_1 + V_2 + \dots + V_n$
$V_n = V_s \times (R_n / R_T)$
$I_T = I_1 = I_2 = I_n$
$R_T = R_1 + R_2 + \dots + R_n$
$Z_T = Z_1 + Z_2 + \dots + Z_n$
$Z_T = 1/Y_T$
$Y_T = 1/Z_T$
$Y_T = Y_1 + Y_2 + \dots + Y_n$
$P_T = P_1 + P_2 \dots + P_n$

Parallel Circuits

$V_T = V_1 = V_2 = V_n$
$I_T = I_1 + I_2 + \dots + I_n$
$I_n = I_s \times (R_T / R_n)$
$R_T = 1/(1/R_1 + 1/R_2 + \dots + 1/R_n)$
$Z_T = 1/(1/Z_1 + 1/Z_2 + \dots + 1/Z_n)$
$Y_T = 1/Z_T$
$P_T = P_1 + P_2 \dots + P_n$

Kirchhoff's voltage law

$V_s = V_1 + V_2 + \dots + V_n$
$V_s = V_1 - V_2 - \dots - V_n = 0$

Voltage-divider formula

$V_x = (R_x / R_T) * V_s$

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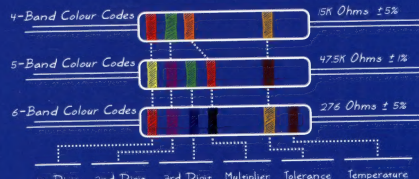
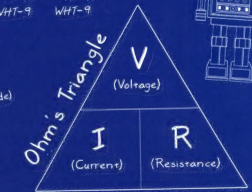
COUPON CODE = pi = '3.1415926'

Resistor Colour Codes



1st Digit	2nd Digit	3rd Digit	Multiplier	Tolerance	Temperature Coefficient
BLK-0	BLK-0	BLK-0	BLK-0	SLV ± 10%	BRN 100ppm
BRN-1	BRN-1	BRN-1	BRN-1	GLD ± 5%	RED 50ppm
RED-2	RED-2	RED-2	RED-2	BRN ± 1%	ORN 15ppm
ORN-3	ORN-3	ORN-3	ORN-3	RED ± 2%	YEL 25ppm
YEL-4	YEL-4	YEL-4	YEL-4	GRN ± 0.5%	
GRN-5	GRN-5	GRN-5	GRN-5	BLU ± 0.25%	
BLU-6	BLU-6	BLU-6	BLU-6	VIO ± 0.1%	
VIO-7	VIO-7	VIO-7	VIO-7		
GRY-8	GRY-8	GRY-8	GRY-8		
WHT-9	WHT-9	WHT-9	WHT-9		



Cover the variable you want to find and perform the resulting calculation (*Multiplication/Division*) as indicated.

About Us

*This Cheat Sheet is brought to you by Little Bird Electronics.
Little Bird Electronics is a boutique online electronics distributor run by Madeleine and Marcus. We stock Arduino, Breakout Boards, Cellular Modules, Components, Development Tools, GPS Modules, LCDs, Programmers, Prototyping Kits, RFID, Robotics Parts, Sensors, Tools, XBee and more!

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